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NOTICE TO SUBSCRIBERS.

The combined paper, the ELECTRICAL WORLD AND ELECTRICAL ENGINEER, of which the issue of March 11, 1899, was the first number, will hereafter be sent to all subscribers of THE ELECTRICAL WORLD and of THE ELECTRICAL ENGINEER in accordance with the separate lists of those two journals. Where subscriptions overlap, credit will be extended to the full amount of the unexpired term of the payment, the price remaining as before, $3 per year, for 52 weekly issues. Prompt notification is earnestly requested of any failure to receive the new journal.

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ECCLESIASTICAL ELECTRICITY.

In aid of the fund for lighting St. Paul's Cathedral in London with electricity, Mr. J. Pierpont Morgan has given the handsome sum of $25,000. How much lighting that will do in the grandly sooty pile it is hard to say, but the gift is generous, and is another link in the bands of Anglo-American amity. The vaults where England's mightiest warriors lie are, to an American eye, equally bright with the apses, nave, corridors and chapels where, in dim and dusty splendor, other heroes down to Chinese Gordon are eternally commemorated; but the electric light may do much to relieve the gloom under the dome and make the worshipper rejoice. In this country this form of illumination has so long prevailed it is not easy to understand the European lag, but the reluctance on the part of ecclesiastical authorities generally may have originated in the attitude of the Vatican, which for many years was opposed to innovation of this character, some of its officials going so far as to ban the incandescent lamp as sacrilegious. In our American churches of all creeds to-day the electric light is found, however, and more than one cross shines nightly far above the darkened cities, while the number of church organs depending on electric motors has long escaped registration. Electricity is distinctly recognized now as a means of grace.

THE HARNESS TRADE.

It has been said that misfortune brings strange bedfellows together, but perhaps prosperity is not less responsible for the juxtaposition. One man's meat is proverbially another man's poison, but it should nevertheless remain true that the happiest conditions are served when every man is able to get cheapest what suits him best, a goal toward which the whole aim of modern life is directed, more or less unconsciously. Electricity as a kind of universal agent or solvent has been in the peculiar attitude of changing men's relations to one another and to nature very remarkably and very suddenly. "Behold, I make all things new," is its particular motto, and while the gain to the human race is evident in the long run, the immediate, inconvenient uncertainty and shifting of conditions are equally plain. The way in which electricity sticks its nose into one art after another, in most disagreeable and intrusive fashion, is well exemplified by its latest evolution, the automobile. The horse being relegated to the rear, with his oats and his hostlers, the next people in line to be worried are the carriage builders. No one knows just where they are coming out as manufacturers under the new régime. Probably it rests with themselves. But when you reach a third class, the harness trade, it does seem as though it was a matter not of an open door but a closed one. The automobile needs no harness. The Whip Trust can crack no whistling thong around its ears. For its mouth no bit, and for its tail no tie, is needed; nor does any saddle chafe its back. Its withers are unwrung. We must confess our belief that for many such staples of the old horse business a narrowing market is to be expected, unless the cheapening of horse-

flesh evens matters up. And just as the horse's arena of usefulness closes in, there must come a widening market for many new specialties created as auxiliaries for the automobile industry.

WINTER WARFARE WITH THE SEA.

It was one of the traditions of old warfare that when winter came on armies that had been busily contending in the field for supremacy should go into their entrenchments, suspend operations of hostility, and not resume the fight until the end of a recognized term of hibernation. The genius who first refused to adhere to a "close season" for killing men did as much to revolutionize war as gunpowder or machine guns. It is in such a class of high merit that Capt. Samuel Trott belonged, as a type of the sailor indifferent to wind and weather. In the early days of submarine telegraphy it was tacitly assumed that laying and repair in winter were out of the question, and the expense indeed proved enormous when any effort was made to avoid the loss due to the suspension of earning power for so many months, should a cable be broken. But Captain Trott, with a native genius for cable work, and with a seamanship to which full credit has not yet been given, brushed aside all the difficulties due to wintry storms in the Atlantic and achieved wonders in the way of speedy and cheap repairs, when all the conditions were adverse. In fact, it might fairly be said that to his passionate desire to overcome obstacles he owed his death; for he insisted on exposing himself and his ship to all the perils of March off the Newfoundland coast, simply that he might do his duty and maintain his record as a winter fighter. Men of this stamp are ill-spared.

CHEAP TELEPHONY.

The recent meeting of "independent" telephonists at Cleveland was an evidence of the intrinsic strength of this movement in many parts of the country. No one can read the report given in our columns this week without realizing that here is an element of opposition which "will not down" readily. Cupidity loves a shining mark, and the prosperity of the Bell telephone system has invited competitors into the field animated often by mere purposes of gain; but it is undeniable that a large part of the present activity began in a general public desire for cheaper service and lower rates. The "independent" movement is doing much towards that end, but there is no reason why the economic tendencies within the Bell régime itself should be overlooked. Those who come in contact with leaders of the "old line" service know how studious many of them have been to devise methods of universalizing the telephone.

Mr. Chas. J. Glidden, president of the Bell-Erie system, in a recent interview in a Cleveland, Ohio, newspaper, stated that his company had made a new departure in commercial telephony that would place the instruments in the service of people of moderate income. There was no reason, he said, why the clerk earning $75 per month should not have in his home the advantages and protection of the telephone connected with the general system, as well as those having larger income and extensive business interests throughout the country. The new feature will provide a telephone for the people of moderate income in a city the size of Cleveland at a cost not to exceed 5 cents per day. This permits the subscriber to use the telephone from his residence once, but the residence may be called an unlimited number of times. In order to furnish the telephone at this low rate a number of subscribers must be connected on the same circuit, as many as ten with five on each side. In cases of this kind the long distance and best metallic circuit can be furnished. The telephone on the premises furnishes the family of the subscriber protection in many ways and enables them to call once a day for 5 cents, as above stated, and be called as many times as may be desired.

The Erie system, which operates over 58,000 subscribers, has put this service in force throughout its entire territory, covering seven of the important states, including such cities as Minneapolis, St. Paul, Detroit, Cleveland, Galveston, Houston, Dallas, Fort Worth, and in fact all its exchanges. It will be most interesting to watch the results attained under this new plan, approaches toward which had already been made gradually.

HIGH VS. LOW ECONOMY INCANDESCENT LAMPS.

Much misapprehension appears to exist as to the difference between high and low economy incandescent lamps, and the lamp manufacturer is often unjustly made the target of complaints due to this condition. It should now be generally recognized that the rating of a lamp as of high economy or low economy is based, not upon differences of manufacture, but upon the voltage at which it is used. That is, a 3.1-watt lamp at one voltage will be a 4-watt lamp at another; or, to put it in another way, a lamp that at 20 candle power is a high-economy lamp when burned at 16 candle power is a low-economy lamp. Economy in the sense used applies, however, only to the consumption of electrical energy, for there would be little economy in using a high-economy lamp on a circuit of poor regulation, owing to the short life that would ensue.

The subject of the dependence of the economy and the life of a lamp upon the degree of incandescence of the filament is one which was thoroughly expounded in the first years of electric lighting, and though the principles concerned are very simple to grasp, the subject appears to be far from being understood by all central station men. So true is this that the lamp seller has had usually to take upon himself the selection of the grade of lamp best suited to given conditions, and in return has often been suspected of supplying low-economy lamps from ulterior motives. This care for the central station man, to be sure, has not been unselfish, but due to the fact that it is to the interest of the lamp manufacturer not to sell high-economy lamps to stations having poor regulation; for should he do so his lamps would be apt to be condemned in spite of any explanation, however intelligent, he might make of the principles governing the life of a lamp. In another column we print a letter bearing upon the subject here touched, which gives some excellent advice to those who would use high-economy lamps.

SOME FEATURES OF ENGLISH CENTRAL-STATION PRACTICE.

There will be found on other pages an article describing two English central stations of recent construction. These electricity works, as the English call them, exhibit practically all the peculiarities that distinguish central-station design in England from that in America. They contain internal-furnace boilers, high-speed single-acting vertical engines, direct-coupled to shunt-wound bipolar under-type generators, connected to switchboards with under-load, instead of over-load, circuit breakers, and supplying underground feeders and mains of concentric cable laid solid in the conduits. There is, of course, only one style of current generated, and this is direct current on the three-wire system with 440 volts between the outers. In one of these stations one generating unit comprises two dynamos each of half the voltage between outers, connected in series with each other to give a balance between the neutral and the two outer mains of the system in the way customarily used by the Edison companies in this country. These two machines are not coupled to the two ends of the crank shaft, but are coupled to each other with the engine outside of them at one end of the group. The other dynamos in this station each generate the full pressure of the supply system, 440 volts, and are connected in multiple directly across the outers. The risk of loss of balance in case the one divided set should break down is not as great as would appear, as the storage

battery with which the plant is equipped will maintain the balance without the use of the divided generators. Two boosters are provided, one for each polarity of the storage battery with end-cell switches for use when the boosters are shut down. These two methods of battery regulation are never provided together in this country.

In the other station there are only two generators, and each of them delivers the full voltage between outers, the balance being maintained, as is occasionally done in this country, by means of two 220-volt machines coupled together, connected in series with each other across the outers, with the neutral connected between them and acting as a motor-generator to maintain the balance of voltage between the two sides of the system. These two machines also serve as a motor, driving the two boosters, one for each polarity of the system.

Practically all direct-current central stations in England are now worked upon the three-wire system with high-voltage lamps each side of the neutral. This combination is yet not used on this side of the water, but it will probably come into considerable favor as soon as the fundamental patent upon the three-wire system expires, which will be just one year hence. The English plan will allow much greater areas to be covered from one station with a given amount of copper and a given drop than can be reached with the present direct-current voltages, increasing the economy of production sufficiently to more than compensate for the lower economy of high-voltage lamps. Better interior wiring and more carefully insulated sockets and other fixtures will be necessary, as there will be practically street railway voltage on the system, although it is not necessary to introduce more than half this pressure into the consumers' premises, and the risk of getting a shock of more than 220 volts may be, and is, in England, customarily eliminated by grounding the neutral. In short, the system is one which, in the case of towns and smaller cities, enables the direct current to compete with the alternating current.

TWO-PHASE VERSUS THREE-PHASE SYSTEMS.

The relative advantages of the two-phase and three-phase systems of distribution are much debated among electrical engineers. Those who are in favor of the three-phase system point to its economy in conductors for the purposes of transmission to a distance; while those who advocate the two-phase system claim for it a greater simplicity and flexibility, as well as a greater output of two-phase converters compared with three-phase converters. It has long been known that the three-phase system requires 25 per cent. less copper for a given power transmission at the same line loss and maximum pressure between any pair of conductors. For this reason most of the high-pressure, long-distance systems of transmission employ three-phase electromotive forces and currents, although, in some cases, these are obtained from two-phase generators through the interposition of two-phase-three-phase transformers. On the other hand, the two-phase advocates point out that the two circuits of their system are more completely independent of each other than are the circuits of the three-phase system, partly because they are not so likely to be seriously unbalanced in pressure by dissymmetry of loads, and partly because their circuits may be run independently of each other, and only united at those places where motors have to be operated.

In regard to step-down transformers, the two-phase system requires only two at any point of supply; whereas, the three-phase system employs three transformers whenever the power to be delivered exceeds, say, 20 or 30 kilowatts. In the case of converters, it is claimed that the two-phase system taps the equivalent two-pole revolving armature at four points, whereas the three-phase system taps it only at three; and since the more numerous the taps the less the average heating of the conductors, the two-phase converter will give about 25 per cent. more output for a given loss of power by heat in conductors than the same machine used as a three-phase converter. Against this the three-phase advocates urge that it is possible to tap the converter armature in six places, and connect these by six wires with the coils of three-phase transformers, and by this means turn the tables and obtain a yet greater output for the three-phase system locally converted into six-phase. Judging from the number of both two-phase and three-phase plants that are doing good service in different parts of the world, it would seem that no general conclusions have been reached up to the present time in favor of either system. In fact, it would appear that the preference in any given case depends upon local conditions. Thus, a long-distance transmission of power in large units, to a limited number of consumers, would be likely to display the advantages of the three-phase system. On the other hand, it might be expected that the advantages of the two-phase system would be particularly favorable to its use on a short-distance general-distribution system to many consumers. As regards converters, it is seldom that their expense forms so large an item in the total cost of a plant as to exercise appreciable weight in the decision.

The converter has not only been one of the latest dynamo-electric machines to come into extensive use, but it is also one of the most complex. It inherits all the waywardness of its alternating-current mother, due to its operation as a synchronous multiphase motor, and all the complexities of its masculine progenitor, the direct-current generator. But it also develops a goodly number of perplexities, which are exclusively its own, by virtue of the mingling of both alternating and direct currents in one and the same winding. A well-behaved converter is one of the most efficient, smooth-running and satisfactory machines known in the electrical engineering art. The occasional bad behavior of some of them, however, has given the whole class a bad reputation in the minds of not a few station managers. By proper management converters are capable of markedly assisting the regulation of the system to which they are applied; but, under careless treatment, they have been known to spark at the brushes, to hunt in speed, to oscillate in pressure and pump in current, with the elusiveness of the squirrel and the obliquity of the mule. The causes which are at work in developing these wayward peculiarities are of the most complex character, and are by no means yet completely understood. It is known that the reactions of the current in the armature conductors upon the magnetic circuit may, under certain circumstances, become rhythmic, but the complete analysis and solution of the difficulty are yet to be looked for.

Another peculiarity of the converter is the awkwardness of the ratios between alternating and continuous current pressures, on its two sides. In the case of a dynamotor, this ratio is determined by the number of conductors in the two separate but mechanically associated windings, and can be changed by the designer within fairly wide limits, according to the requirements of the case. But in the converter the ratio is fixed and by no means a simple number, even when we assume the simplest conditions, with pressure and currents of the strictly sinusoidal type. Thus, the alternating pressure of a two-phase converter is about 71 per cent., and of the three-phase converter about 61 per cent. of the direct pressure measured at the brushes, while, owing to the variations in the wave form of current and pressure, as well as to the distribution of the magnetic flux passing through the poles into the armature, these ratios become modified within a range of about 10 per cent. It is to be hoped that electrical engineering has no more complex machines in store for its students than the converter, at least in the near future.

Large Transformers for Niagara.

An order has been given by the Niagara Falls Power Company for seven 2500-hp Westinghouse transformers, the largest units thus far attempted. They will be of the same type and of the same general appearance as the four 850-kw transformers built by the same company for the Cataract Power & Conduit Company, and installed about a year ago in the Ohio Street sub-station in Buffalo.

The efficiency of these transformers will be high. At full load it will be considerably over 98 per cent., and at half load it will also be above 98 per cent., while at quarter load it will exceed 97 per cent. They will be used in stepping-up the two-phase, 2200-volt current from the generators to three-phase, 4400-volt current for supplying the Union Carbide Company. They may also be used in stepping-up to 11,000 and 22,000 volts, three-phase. these being the voltages used in transmitting the power to Buffalo; or they may be employed as reducing transformers, lowering from 11,000 or 22,000 volts, three-phase, to 2200 or 4400 volts, two-phase or three-phase.

Preparations for the Coming Electrical Exhibition.

Work is being pushed apace for the Electrical Exhibition to be held at Madison Square Garden, New York city, from May 8 to June 3, and the contracts already signed for space are far in excess of those made at the same date last year. Not less than about 3000 square feet will be occupied by automobiles, the Pope, Riker and Indiana Bicycle companies, as well as others, making superb displays in this line, with spaces across the centre of the building. One admirable arrangement is that all exhibits will be made this year in the amphitheatre. Exhibitors of boilers, engines and steam specialties will undoubtedly be pleased with this plan, which brings them up from the basement on to the main floor of the exhibition hall. The space allotted for these lines is almost entirely disposed of at this early date, so that exhibitors interested will do well to make speedy application. A special section will be set aside for patents and inventions, the idea being to enable inventors whose goods are not yet on the market to display them here to thousands of interested persons, including a number of investors, at small cost. During the month the National Electric Light Association will hold its convention at the Garden, and other engineering bodies are also to take advantage of the opportunity thus offered for the study of all that is latest and best in electrical and mechanical advances. Special attention will be given to matters connected with export trade.

Coal Production of the United States.

The announcement that the rapid increase in exportation of coal from the United States is causing uneasiness among British coal producers and exporters lends interest to some figures on the coal production of the world, and especially of the United States, just isued by the Treasury Bureau of Statistics. From these it appears that the coal production of the United States is now nearly five times as much as in 1870; that the exportation has in that time increased from a quarter of a million tons to over four million tons, and that the United States, which in 1870 supplied but 17 per cent. of the world's output, now furnishes about 25 per cent.

No other country shows such a rapid increase in coal production as does the United States. The growth of production of the leading countries, comparing the average annual output in the period 1871-85 with that of the period 1891-5, is shown in the following table:

Great Britain	45 per cent.
France	70 " "
Germany	115 " "
Other countries (omitting the United States)	132 " "
World (omitting the United States)	75 " "
World (including the United States)	95 " "
United States	193 " "

The area of coal production in the United States has increased, as well as the quantity. In 1870 coal was produced in twenty States, while in 1897 the output came from thirty-two States. The total quantity produced in the United States in the year 1870 was 32,863,600 tons, and in 1897 it was 147,860,380 tons. The average annual price per ton of anthracite at Philadelphia and of bituminous at Baltimore has steadily decreased during the 1870-1898 period. In the former year anthracite cost $4.39 per ton, while in 1898 it had fallen to $3.50. Bituminous coal in 1870 brought $4.72 per ton on the average, and in 1898 it was $1.60. The exportations from the United States show some interesting figures. In 1870 these were 227,918 tons, and in 1898, 4,008,996 tons.

Data on the Recent Storage Battery Developments.

Some very interesting details were made public last week as to the relations between the Electric Storage Battery Company, of Philadelphia; the Electric Vehicle Company, of New York, and various other electrical vehicle companies which have been formed lately. The Philadelphia company, the controlling interest in which was recently secured by the Whitney-Brady-Ryan syndicate, is the primary company, formed, as readers of this journal know, out of the consolidation of various storage battery interests in this country. It is capitalized with $12,500,000 of common and $5,000,000 of preferred stock, which is to pay cumulative dividends of only 1 per cent. The company has never paid a dividend yet, and may not do so in a year or more, although its earnings are very large and orders are far in excess of its present capacity to fill them. Among its big contracts is one with the Metropolitan Street Railway Company, of New York, for about $3,000,000 worth of storage batteries.

The company was impressed with the possibilities of the development of electric vehicles, and was induced by this tempting field to organize the Electric Vehicle Company, of New York, the Electric Storage Battery Company, then the principal company of the present Philadelphia combination, subscribing 2500 shares of the stock of the new company.

The Electric Vehicle Company has been in existence about three years, and was organized with a capital of $5,000,000 of common stock, all issued, and $5,000,000 of preferred stock, of which only $1,000,000 has been issued. It was the first of the electric vehicle companies organied, and of others in process of organization. Its ingenious and interesting plant in New York city has been described in the electrical press. It subscribes 10 per cent. of the stock of these smaller companies, and each of these lesser concerns pays a license tax to the Electric Vehicle Company of one cent per capita of the population of the territory in which it obtains rights, and in addition it pays a small percentage of its gross receipts. The New York plant has been sold to the New York Electric Cab & Transportation Company, which has a capital stock of $25,000,000, and which is said to have given $300,000 for the plant as it stands, the new capital going out for the extensions, etc.

The Electric Vehicle Company will place orders for 12,000 cabs this year if the cab manufacturers of the country can build that number. The company has in view the expansion of its business in more than one direction. Considerable attention is being given to the matter of introducing electricity as the motive power for the delivery wagons of the big stores, and the promoters of the company expect practical results in that line before the end of the year. It is likely that the Metropolitan Street Railway Company will supply power to cabs and wagons, and it is not improbable that some sort of transfer system will be devised whereby electric cabs will take passengers from the door of their houses to the Metropolitan Street Railway trunk lines.

Among the subsidiary companies is the Pennsylvania Electric Company, of Philadelphia, which has the right to operate in the whole of Pennsylvania. Companies are being organized in Chicago, Boston, Washington and other cities.

The Electric Storage Battery Company is also the parent of the Electric Boat Company, organized about a month ago with $5,000,000 comon stock, all issued, and $5,000,000 preferred stock, of which $1,000,000 was subscribed for at par. Twenty-five per cent. has been paid in. The company has purchased the Holland Torpedo Boat Company and will push that enterprise. The company proposes to build 1000 electric launches. The equipment of ferry-boats with electric storage batteries will also be a part of the business. In all these various enterprises Mr. Isaac L. Rice has been an active and progressive leader. His faith in electric automobilism was shown at an early stage, when the chief results were those of discouragement.

Two New English Direct-Current, High-Voltage, Three-Wire Central Stations.

AS has been from time to time noted in these columns, the tendency in England has for several years set strongly toward the use of 220 volts, direct current, for central-station work. As examples of the latest development in this system, we illustrate herewith two new stations recently there started, in which the three-wire high-voltage system is used.

One of these stations is located at Lincoln, and though regular supply was commenced in December of last year it is only recently that the station has been practically completed. It is interesting to note that the applications for current have been so numerous that considerable extensions are already necessary, and the plant is soon to be very considerably enlarged. Notwithstanding the fertile field for electric light which this condition so plainly implies, the municipality defeated every attempt to permit its cultivation by private capital, and it was not until 1896 that the town decided to erect a plant from public funds.

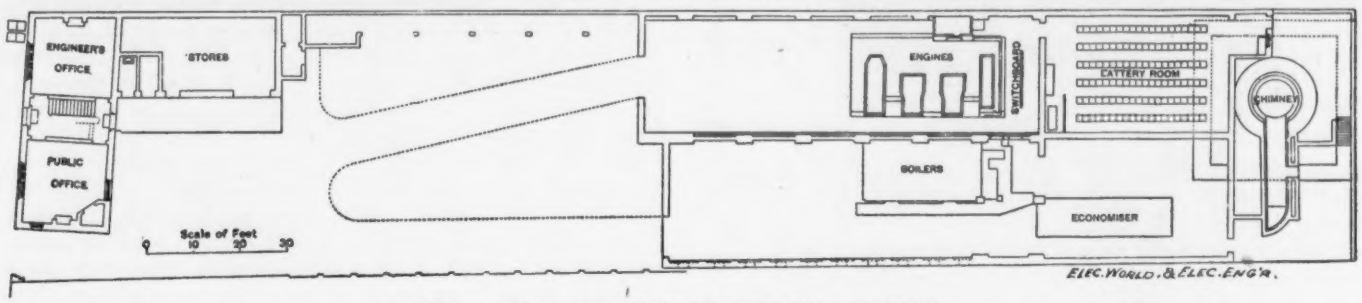

FIG. 1.—PLAN OF LINCOLN CENTRAL STATION.

As is shown in the small view in the centre in the accompanying cut, the generating station is situated at the water side, being on the north bank of the Brayford River. The station, a plan of which is given in Fig. 1, has been built for an eventual capacity of 4000 horse-power. At present there are two boilers (Fig. 5) of the marine type, each 12 feet long by 8 feet 6 inches in diameter. The steam piping, which is of lap-welded steel, is so arranged that in the case of a breakdown of either boiler or any engine the remaining engines can be kept in operation. The feed-water arrangement is in duplicate, there being two pumps, one of which, a duplex pump, is driven by steam, and the other, a triplex pump, direct connected to an inclosed electric motor. The feed water on its way to the boiler is passed through a filter and then through an economizer, the latter consisting of ninety-six tubes arranged in twelve rows.

The condensers are of the ejector type, and one is fitted to each of the three engine sets. Over the space occupied by the pumps and part of the boiler space is a large cast-iron tank of 8000 gallons capacity; water is delivered into this tank by a centrifugal pump driven by an electric motor and descends to the ejectors, which maintain a vacuum of 26 inches at full load.

The engines (Fig. 3) are of the Willans central-valve, high-speed type, and are direct-connected to the generators. There are three

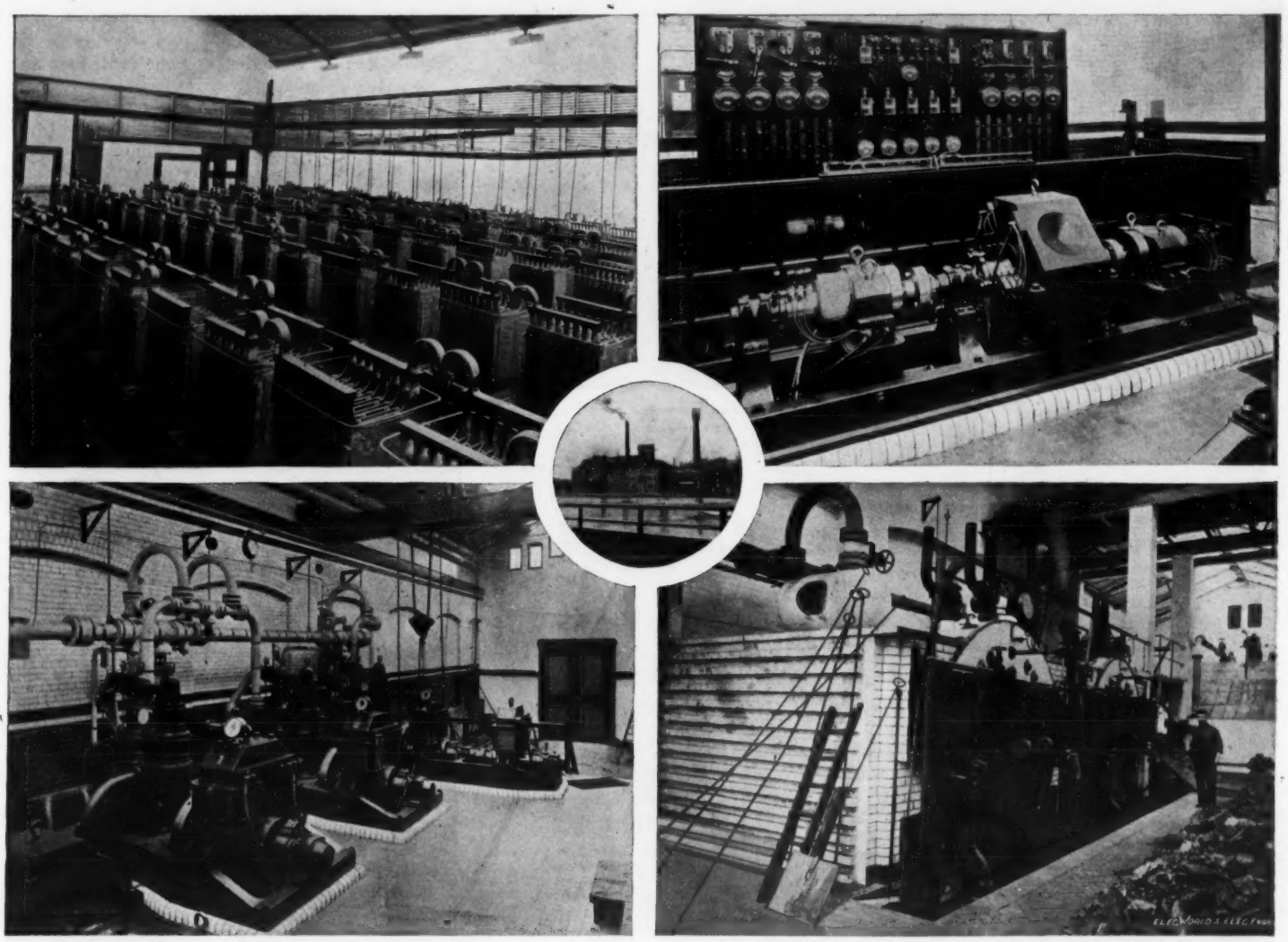

Fig. 2.—Storage Battery Room.
Fig. 3.—Generator Room.

LINCOLN CENTRAL STATION.

Fig. 4.—Booster and Switchboard.
Fig. 5.—Boiler Room.

sets of these latter, one of which is divided into two separate generators. The normal capacity of each set is 50 kilowatts, and the overload capacity 66 kilowatts. As the plant is on the three-wire

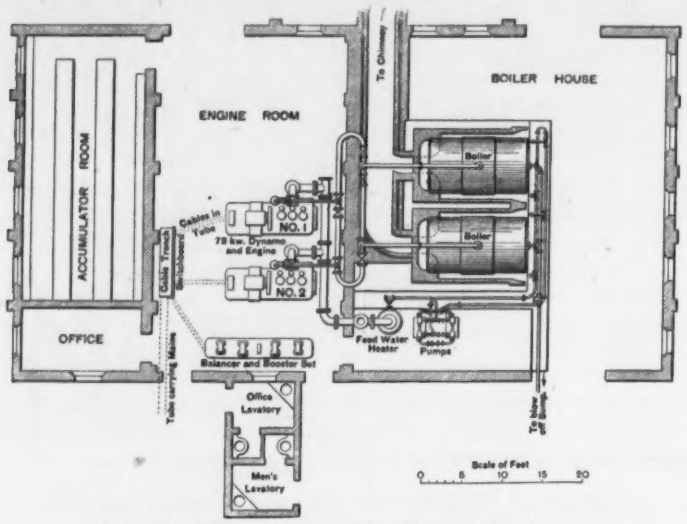

Fig. 6.—Plan of Wycombe Central Station.

system, it will be seen that this gives one large generating unit, consisting of two engine and generator sets, and a smaller unit consisting of the divided generator and its engine. In addition, there is a motor booster, for charging the end cells of the battery, shown in Fig. 4, a portion being also shown in the lower left-hand corner of Fig. 3. The booster is so arranged that it can be used in series with the cells, and adds to the voltage of the dynamo when it is charging the battery, and to the voltage of the cells when they discharge. During light loads the voltage is regulated by cutting cells in and out, and the commutating switch is interlocked with the booster reversing switch, thus insuring against error and simplifying the switchboard attendant's duties. A 6-ton hand crane travels the entire length of the engine room.

The storage battery consists of 240 "chloride" cells in glass boxes, seventeen plates to the cell, and capable of discharging at a maximum rate of 150 amperes. A small motor generator in the battery room is used for charging or "milking" weak cells.

Fig. 10 shows diagrammatically the distributing network. The station is situated at *A*, and there are feeding points at *B*, *C* and *D*. The network contains at present about 4¾ miles of frontage. Wherever a heavy demand was anticipated, or where supply is only on one side of the street, triple-concentric cables have been laid, which are indicated in Fig. 10 by heavy black lines. In all other places the cables are double-concentric, indicated by hatched lines. Throughout the system the distributing cables have a copper section of 0.075 square inch. The cables are laid in a wooden trench made of timber well soaked in Stockholm tar, bitumen being then run in to a thickness of about three-quarters of an inch. At street crossings, under wood pavement and at various important junctions, cast-iron pipes for drawing in have been provided.

For street lighting at present thirty arc lamps have been installed, together with a number of incandescent lamps for use after 11.30 p. m., when the arcs are turned off. The arcs are of both the open and inclosed type, the latter being used in the wider streets.

The charges for service have been fixed at 12 cents per kw-hour for the first hour's average maximum demand, and 5 cents per kw hour for all beyond that consumption. Accounts are rendered quarterly, and there are no meter rents. An additional capacity of 400 kilowatts is to be added, and the cable frontage increased to 10 miles.

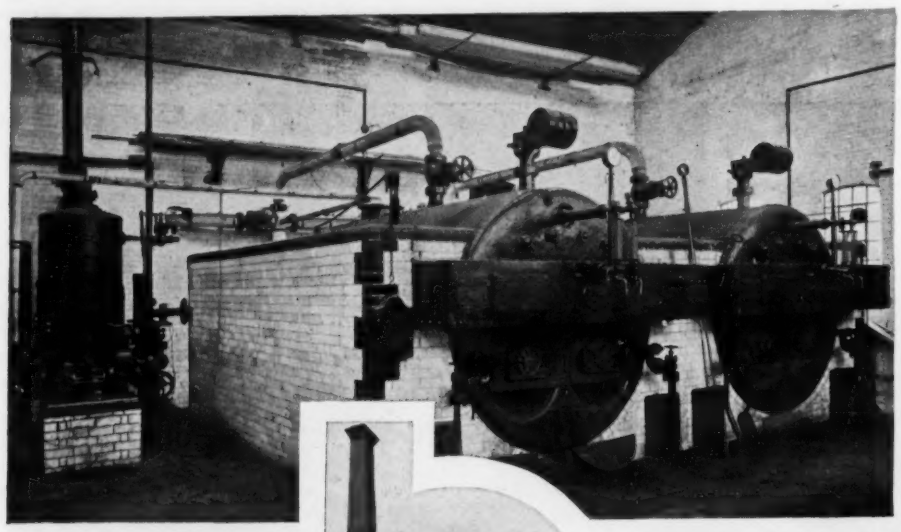

Fig. 7.—Boiler Room.

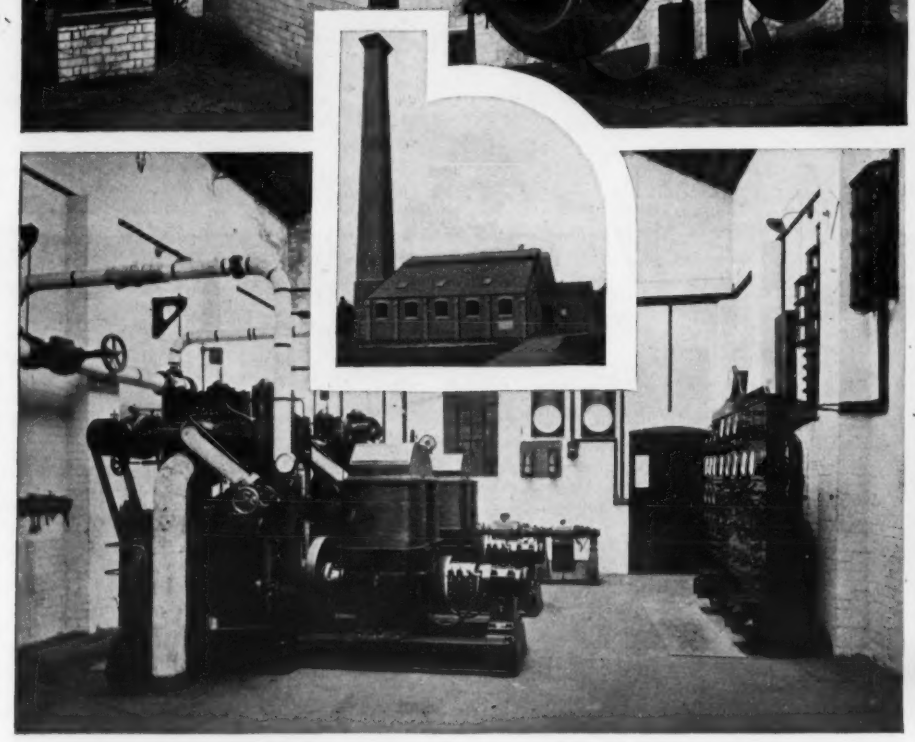

Fig. 8.—Generator Room.

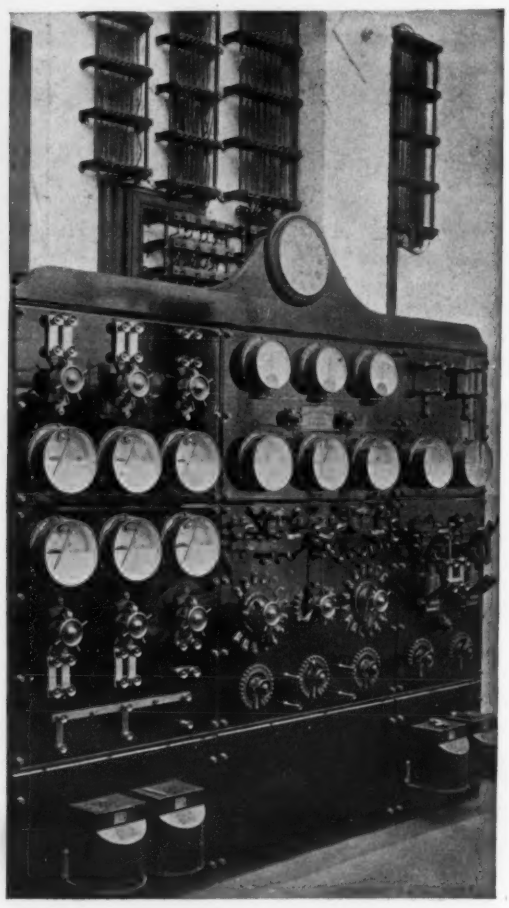

Fig. 9.—Switchboard.

WYCOMBE CENTRAL STATION.

Figs. 6 to 9 refer to a central station recently erected at Wycombe, an English town of about 22,000 inhabitants. The municipality in this case also appears to have played the dog-in-the-manger policy, and after having obtained authority to build a plant

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some five years ago finally turned the matter over to private enterprise. One of the clauses in the contract with the central station company is that interior wiring shall be done without initial charge, payment to be made at the rate of 18 cents per lamp per quarter until the cost of the wiring is defrayed. At the beginning of this year from 1500 to 1800 8-cp lamps were connected, and since then nearly 1000 more have been added. For the streets 200 incandescent and five arc lamps are used. Three open arcs are connected in series on one side of the neutral and two inclosed arcs in series on the other.

Fig. 6 is a plan of the station, which is centrally located, and in Fig. 7 is shown the boiler plant, the latter consisting of two so-called "Economic" boilers, each 12 feet long by 7 feet 6 inches in diameter, and carrying a pressure of 160 pounds. As in the case of the Lincoln plant, there is a duplicate feed-water arrangement, with valves to cut off any defective portion. The engine piping is of the "ring" system, as in the case of the Lincoln plant.

There is one generating unit (Fig. 8), consisting of two sets of direct-connected engine and dynamo. Each engine is of 120 horsepower at 480 r. p. m., and the generators, which are shunt-wound, have each a capacity of 160 amperes at 420 to 460 volts. There is also a balancer-booster, consisting of two machines with armatures

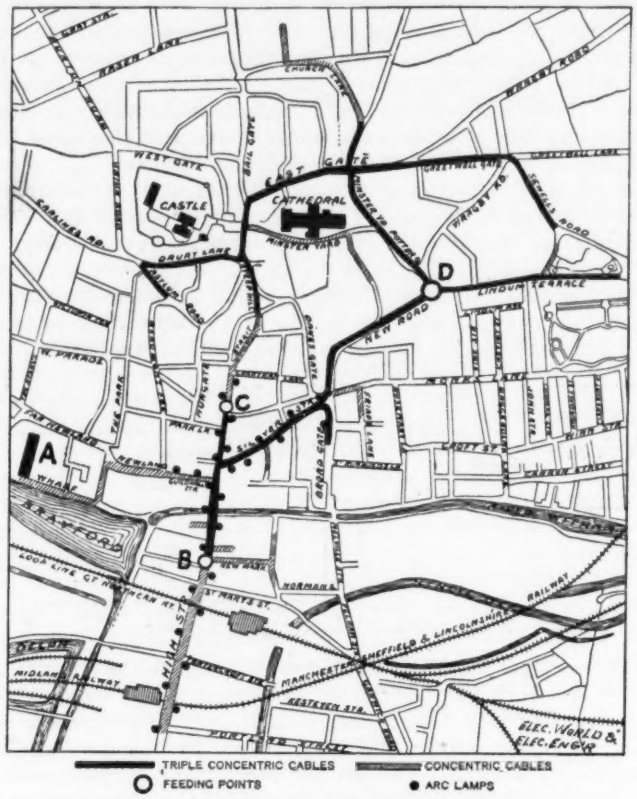


Fig. 10.—Lincoln Distributing Network.

wound for 50 amperes at 210 to 230 volts, and a speed of 850 r. p. m These machines are flexibly coupled, and on an extension of the shaft at each end is a smaller booster for charging the battery. The armatures of these latter are wound for 70 amperes, and will raise the pressure by any amount up to 70 volts. The storage battery consists of 230 cells, having a capacity of 585 ampere-hours when discharging at the rate of 65 amperes.

The switchboard, shown in Fig. 9, is of enameled slate with three panels; the left-hand panel is for three feeders, the central

Feeder No. 1.....	662	yards	.100	.06	.100
Feeder No. 2.....	321	„	.100	.06	.100
Feeder No. 3.....	1,020	„	.100	.06	.100
Distributors	2,480	„	.075	.05	.075
Distributors	5,060	„	.05	.03	.05
Arc lamps	420	„	.012	.012	.012
Incandescent street-lighting	7,750	„	.008	.008	.008
			.008	.008	—

panel provides for the neutral and accumulator arrangements, and the right-hand panel for the dynamo connections. The dynamo panel is fitted with both circuit breakers and fuses.

There are three feeders, one leading to the centre and one to each side of the lighting district. These are of the triple-concentric type, lead-covered and armored. The two main conductors have a sectional area of .1 square inch, and the neutral of .06 square inch. The distributing mains are also triple-concentric, and of two sizes—the outsides being .075 and .05 square inch, respectively, and the neutrals .05 and .03, respectively. The arc lamp cables have all three conductors of .012 square inch area, and the incandescent street lighting cables are of .008 square inch section. The accompanying table is a schedule of the various cables used, all being concentric. The second column gives the lengths employed, the third and fifth columns the areas of the outside conductors, and the fourth column the area of the inside conductor.

Observations on the Wehnelt Interrupter.

BY GEORGE T. HANCHETT AND CHARLES T. CHILD.

THE great interest aroused by the publication of Dr. Wehnelt's recent article, describing his ingenious current interrupter, has led the writers to undertake some simple experimental researches upon various forms of the interrupter, with a view to determining the best form to be given it, and how it might best serve the purpose for which it was intended.

The original description of the apparatus was illustrated with the figure here reproduced (Fig. 1). This shows the interrupter to consist of a vessel *a*, containing sulphuric acid and water, with a lead plate *b*, as cathode, and a glass tube filled with mercury *d*, and terminating in a point of platinum wire *c*, as anode. With an instrument exactly in this form most surprising results were obtained. The interrupter was connected in series with an oil-insulated induction coil, containing about 4½ pounds of secondary wire, and connected across direct-current lighting mains at a difference of potential of 120 volts. The action was extremely violent. The frequency of interruption, judging from the definite musical pitch of the tone given out, was in the neighborhood of 550 breaks per second. Between the secondary terminals of the coil a high-frequency arc over 6 inches long was established, and, upon the withdrawal of the terminals to a further distance, a brilliant shower of blue sparks was observed. When the terminals were separated beyond the striking distance of the coils both were clothed with purple brush discharges of great beauty. The discharge is highly calorific, and will readily ignite paper or light wood. When drawn out nearly to its breaking point this arc or flame discharge is marked with beautiful striations. Apparently the discharge is of an almost purely alternating character; it exhibits some phenomena of polarity in vacuum tubes, but much less than ordinary induction coil discharges of the

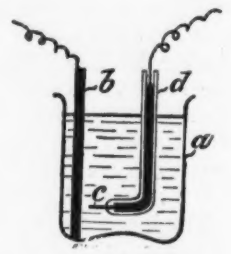


Fig. 1.—Original Wehnelt Interrupter.

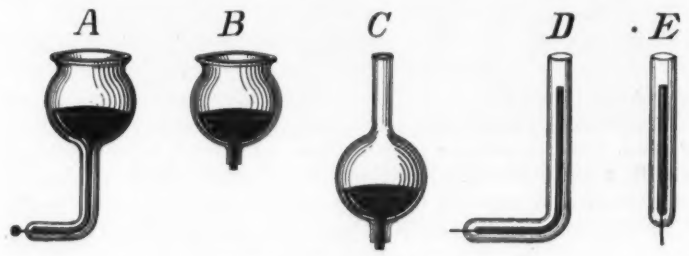


Fig. 2.—Types of Anodes.

same striking distance. The effect upon Crookes tubes, while not of the same character as that produced by the usual unidirectional discharge, accompanied with the production of X-rays, is nevertheless very powerful. The tubes glow with an intense green fluorescence and rapidly become very hot.

An accidental reversal of current through the first interrupter made produced the well-known forge effect, intensely heating the platinum point, which was a piece of No. 22 gauge wire about one-quarter inch long, melting the end of it into a globule or knob, as shown in *A*, Fig. 2. This form was found to be a particularly efficient and satisfactory interrupter for currents up to about 5 amperes; but this interrupter, like the others, could not be forced beyond a certain point. The effect of excessive current passing through the fine platinum wire imbedded in glass naturally caused it to become

very hot and expand, cracking the glass, while the mercury in this form of tube has not sufficient cross-section either to conduct away rapidly the heat produced in the platinum, or of itself withstand the heating effects of the current. Consequently, experiments with this form were often interrupted by the mercury in the lower part of the tube volatilizing, thus establishing an arc and violently blowing most of the mercury out of the tube. The latter was not infrequently broken by the almost explosive violence of this phenomenon.

Observing that the area of platinum exposed seemed to be the first determining factor in the amount of current that would pass under other given conditions, it was determined to use a platinum

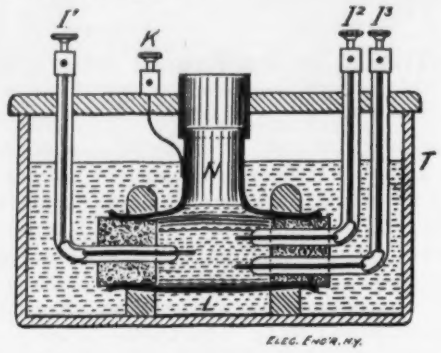


Fig. 3.—Multiple Point Interrupter.

point in the shape of a cylinder of about one-tenth of an inch diameter and three-eighths of an inch long. Great difficulty was found in sealing this into the glass, but this difficulty once overcome that of the small and easily volatilized thread of mercury still remained. This was conquered by blowing a bulb upon the glass (*C*, Fig. 2) directly over the platinum seal, which, containing a large quantity of mercury, gave considerable conductivity and operated to more easily conduct away the heat generated at the point.

The last described arrangement worked very well. It was found, in general, that the best results were obtained if the platinum point was directed straight down, and not turned over toward the plate, as shown in Dr. Wehnelt's drawing, Fig. 1.

Attempts were made to obtain large surfaces of the platinum point and at the same time overcome the difficulty of sealing a large joint in the glass tube, by constructing an interrupter having several small platinum points, instead of one large one, Fig. 3. This worked very well, perhaps best of all, until the heat developed in the platinum point cracked the glass.

It was found that the interrupter, in any of the forms above described, operated upon potential differences of from 20 to 240 volts, the frequency seeming to depend upon the voltage with a given interrupter. Other conditions being the same, the frequency is lower and the current larger when platinum points are used. The shape of the platinum point seems to make no difference whatever, but for some reason those anodes having a straight wire pointing vertically downwards operate best.

If it is attempted to pass excessive current through an interrupter, the heat generated at the point will generally destroy it in a few seconds by cracking the glass tube or volatilizing the mercury. Even under normal working conditions the acidulated water becomes very hot, and, under excessive current, may be carried to the boiling point in a few minutes. Noticing this great evolution of heat, it was attempted to measure the energy lost in the interrupter itself, which was found to be nearly 90 per cent. of that withdrawn from

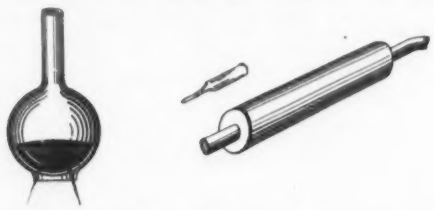


Fig. 4.—Point with Insulating Sleeve.

the circuit. For instance, in an experiment with an interrupter, using about 10 amperes at 120 volts, the fall of potential across the cup terminals was found to be 110 volts, and around the coil terminals only 10 volts. While these readings added together give an accurate total, they are not to be regarded as strictly definite, as the measurements were made with an ordinary Weston voltmeter, certainly not adapted for currents of high frequencies of interruption.

As the electrolyte warms up the operation of the interrupter becomes less satisfactory until it is stopped when the liquid arrives at the boiling point.

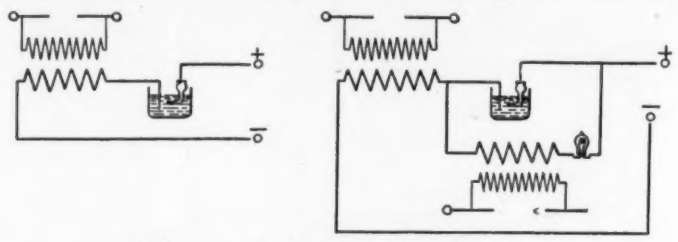
If the apparatus is overloaded it will work for an instant, the length of time seeming to depend upon the amount of overload, and then stop abruptly. It seems then to have permanently succeeded in breaking the circuit, for the current falls to a scarcely measurable value, small bubbles slowly rising from the joint between the platinum and glass. Under these conditions a pinkish glow seems to creep up the wire, between the glass and platinum, almost as if the electric current were searching out a new path or striving to enlarge the area of contact of the metal. Sometimes a jolt given the apparatus will start it working again for an instant. If the current is switched off, a curious sucking sound is heard in the cup, and in a moment the current may be switched on again, the interrupter then starting to work for an instant and stopping as before.

A number of electrolytes were tried, including sodium carbonate and sulphate and solution of sulphuric acid. The latter gives much the best results, when its specific gravity is about 1.2.

From the above results the conclusion may readily be drawn that the best interrupter will be made by using a moderately large straight platinum wire point, sealed in the bottom of a funnel or thistle-shaped vessel, as shown in *B*, Fig. 2, in a solution of sulphuric acid, the whole being arranged with a water-bath to keep it cool. For the benefit of those undertaking to experiment for the first time with this interrupter, it must be remarked that some sort of cover should always be provided for it, as the intensely energetic action taking place throws a fine spray of the acid electrolyte, and sometimes substantial drops, to considerable distances.

The effect of inductive resistance in series with the interrupter seems to be two-fold: it makes the action more reliable and lowers the frequency. The effect of ohmic resistance seems to be simply to cut down the current flowing in the circuit.

Noticing the great fall of potential around the interrupter itself a second coil was connected as shown in Fig. 6, a bank of lamps being introduced to prevent the current in the primary from rising



Figs. 5 and 6.—Interrupter Circuits.

to dangerous values. In the static condition of the interrupter, described above—that is, when it seems to be trying to interrupt, but not succeeding—the lamps were lighted nearly to normal candle power. The interrupter beginning action, in this case with the frequency between 400 and 500 per second, the lamps blazed up with great brilliancy, indicating a rise in voltage of from 50 to 100 per cent. in the circuit; at the same time the second coil worked with great intensity, producing a fine arc discharge at its terminals. This increase of voltage was also noted by Prof. Thomson in his article in these pages last week, in connection with lamps connected across the supply mains. With this arrangement the action was ascribed to the high tension periodicity reflected into the supply leads and supersupposed upon the continuous current. In the case here described it was doubtless due to resonance effects of some sort. Whatever it was, it was sufficient in intensity to occasionally destroy the lamps.

The interrupter may be made by using, instead of a platinum point, a wire of almost any metal thrust through a tightly fitting tube of insulating material, such as hard rubber or fibre (Fig. 4). The baser metals, while showing the Wehnelt effect, almost if not quite as well as platinum, are rapidly eaten away by the action of the current—this being particularly noticeable in the case of brass. The creeping action refefred to above, that is, the tendency of the electrolyte to force itself between the conductor and its sheath, are remarkably well shown in this form of the interrupter, the liquid being spirited out at the end of the insulation tube even if this be 8 or 10 inches long, and the wire tight-fitting throughout its length. Fibre tubes are rapidly eaten away at the end, their substance being apparently destroyed. Such an interrupter, worked in a clear solution, throws off a dark cloud of oxide in a few seconds, and the

liquid becomes turbid, the end of the wire being eaten away, as shown in Fig. 4. Even with platinum there is some corrosion, and the polished surfaces take on a finely granular appearance; but this does not seem to interfere with the operation of the interrupter, or to progress fast enough to be of any importance.

The conclusions to which the writers have been brought from these observations are that the Wehnelt interrupter is not effective for large currents, and that it is wasteful of energy on account of the great dissipation of current in heating the electrolyte. For the operation of X-ray tubes it is not so good as mechanical interrupters, because of the alternating character of the secondary discharges from the coil. For the production of high frequency, alternating currents from a direct-current source it is certainly the most simple and ingenious device that has ever been produced, and, in connection with an induction coil, Thomson multiplying coil, and condenser, can give very brilliant and remarkable effects. Experimenters who may undertake to make this interrupter should be warned that a coil whose insulation is not very good is liable to puncture when used with it, on account of the surprising frequency, the secondary potential rising to a very high figure. At the same time, the amount of current that can be forced through the interrupter is large, and the discharge from the secondary may have dangerous energy. On this account great care should be taken to avoid being shocked.

The Use of the Wehnelt Interrupter.

BY LOUIS S. LEVY.

When announcement of Dr. Wehnelt's experiments was made in the "Electrical Engineer," February 16, I immediately took the matter up, and through Dr. E. G. Roos, of Scranton, who placed his well appointed laboratory at my disposal, I am able to chronicle the following results.

The anode was made of No. 26 platinum wire fused in the end of a glass tube, ⅛ inch bore. The area of the wire exposed to the liquid was proportioned to the current required. In the first experiment 6 mm. were left protruding from the end of the glass tube, giving an area of about 10 square mm. Following the proportions given by Dr. Wehnelt, I found that when the applied e. m. f. was raised so that the current value became more than 4 amperes the interrupter stopped its action, the platinum wire becoming red hot, but with no tendency toward incandescence. This effect is due simply to the inability of the platinum to cool between successive interruptions. This effect is the extreme of those that manifest themselves during the operation of the interrupter at lower e. m. fs. These effects consist of sudden stoppages, which are only of a momentary character, causing, naturally, flickering in the tube, but so rapid is the recovery of the interrupter that the efficient operation of the Crookes tube is not diminished.

When using the interrupter in connection with a coil possessing an ordinary mechanical vibrator it is not necessary to alter the internal primary connections with a view to disconnecting the vibrator. No such precaution is necessary, for I have found that it is practically impossible for a vibrator of ordinary pattern to respond to the rapid interruptions.

It would be well to state the comparative effects of the Wehnelt interrupter and the ordinary form of vibrator. Connections were made to a 6-inch Willyoung coil, and the mechanical vibrator was so adjusted that no movement of the hammer could separate the contacts. A Carpenter enamel rheostat was connected in series with the coil and interrupter for the purpose of varying the applied e. m. f. With all the resistance in circuit a slow rate of interruption was maintained, which caused sparks from the secondary, which could be drawn out to three inches. As the resistance was cut out the length of the path of discharge increased. With an e. m. f. of 110 volts, and a current strength of 3 amperes, with a spark gap of 8 inches, a rapid discharge passed between the secondary binding posts. The tone of this discharge was n
a period of about thirty seconds the characteristic discharge occasioned by the use of the Wehnelt interrupter manifested itself. The peculiarity of the change was the increase in the rate of vibration, the tone of the "flame" being just one octave higher than that of the previous discharge. A considerable diminution of e. m. f. was required to break the flame, for it seemed to be a resonant effect, in which the state of synchronism maintained was difficult to break. It should be understood that the minimum e. m. f. at which the flame could be maintained was not sufficient to start it of itself, but when the fierce discharge was once started by a higher e. m. f. the discharge could be maintained indefinitely at the minimum value referred to.

Now, as to the comparative results with the mechanical vibrator. The Wehnelt interrupter was short circuited and the mechanical vibrator adjusted and note taken of the length of spark with the same applied e. m. f. as in the previous cases. With the terminals separated 6 inches a brush discharge was maintained with the mechanical vibrator, but when the short circuit around the interrupter was opened the brush discharge gave way to the Wehnelt discharge, whose tone was so much higher that even to one moderately familiar with its operation the effect was really startling.

A diminution of the spark gap during a Wehnelt discharge caused a rise in the rate of vibration, for, as Professor Thomson has already pointed out, the current reaches its maximum value in a shorter time. When the gap was reduced too greatly, a stoppage resulted as described before. To overcome this objection the writer devised a slight change in the anode. If the platinum wire,

Radiograph Taken with Interrupter in Circuit.

instead of projecting in a single strand, is doubled, so that the loop projects, the trouble is obviated.

A peculiar effect is noticed when this anode is used. The gas, instead of being violently evolved in all directions, is projected with some velocity in a direction at right angles to the plane of the looped platinum on both sides. The cooling effect on the anode in this case seems to be due to the uniform flow of the solution, occasioned, of course, by the constant projection of gas bubbles.

With the high rate of vibration causing the flame discharge the excitation was entirely too great for a tube to be used in a normal 6-inch tube, when the secondary spark gap was 3 inches and the applied e. m. f. just sufficient to maintain the discharge. To adapt the coil to immediate use at one time two tubes were connected in series, the discharge being led in the same direction through both.

Just as things were "rigged up" an obliging patient came into the office and was immediately seized upon as being an excellent subject. A radiograph of the chest was made with one tube 16 inches from the plate. Instead of the usual forty-minute exposure one of ten minutes sufficed to give excellent results. I send a similar radiograph of the hand, showing great clearness of definition.

Electricity in the Italian Navy—II.

BY GIULIO MARTINEZ.

WITH the adoption by the naval authorities of the policy of largely increasing the application of electric power aboard ship, the matter of increasing loads on the circuit and the consequent necessity for more than one generator brought up the question of parallel operation. There was some hesitation about trying the new experiment, as it was feared that the compound-wound generators would not run well in multiple and would be subject to armature burnouts. However the arrangements were made with great care and forethought, and the results have been all that could be desired. Those who predicted unreliability have been obliged to admit that the new method is both reliable and in many cases advantageous for the operation of the generating plant.

There was on exhibition at Turin a switchboard for the new cruiser Puglia, 2500 tons, now building. But this design has been changed, and the final form is shown in diagram in Fig. 3. There are three bus bars, a positive, a negative and the equalizer; a fourth bar is used for the fields. Three-pole switches (five) connect simultaneously the two poles of the dynamo and the free terminal of the field winding with the three bus bars.

Two double-throw field switches (2) connect the shunt field coil either with the machine terminals (switch down) or with the bus bars (switch up). A duplicate set of circuit breakers, (3) and (4), protect the dynamos and the circuits. There are no fuses, their place being taken by the circuit breakers, which are used also as ordinary switches on both generators and mains. (6) shows the automatic circuit-breakers for breaking the shunt field circuit in case the load becomes too great; (10) is the machine ammeter; (11) is the machine voltmeter; (12) is the circuit ammeter. The individual machine shunt field rheostats are indicated by (7); and (8) is a general shunt field rheostat, which is used when the machines have been thrown on the bus bars and are working in parallel, and are being excited from the bus bars. The main voltmeter is shown at (9). Finally, there is a single pole switch, shown at (1), called a "safety" switch.

Each generator is supposed to correspond to a definite circuit.

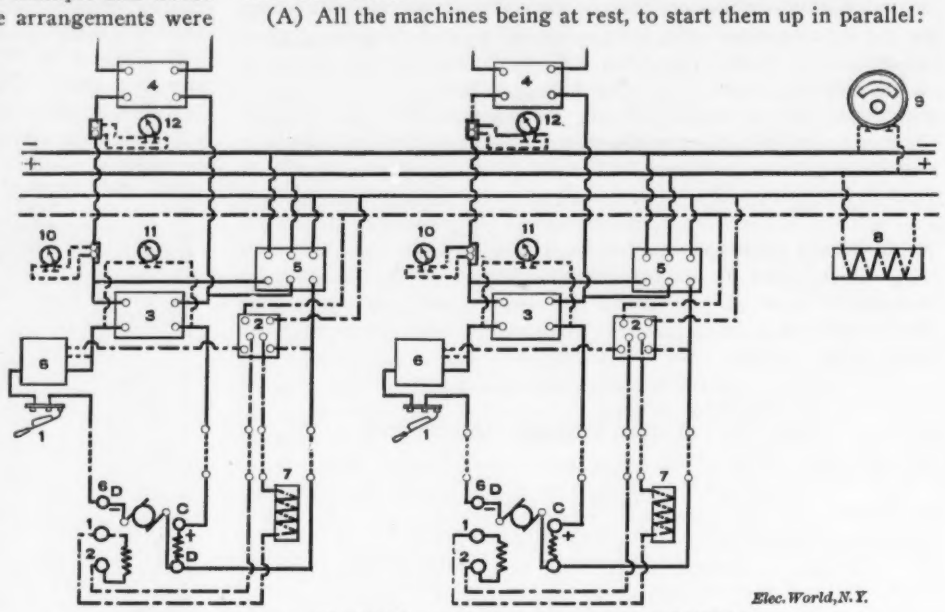


FIG. 3.—DIAGRAM OF PARALLEL DISTRIBUTION.

It should be remembered that the large plants for armored vessels, like the Re Umberto, were designed with every circuit intended to take up the entire output of a machine.

With the increase of load on the circuits, the bus bars become necessary as common reservoirs. Each circuit can be fed either from its own dynamos or from the bus bars. With the double throw field switches closed on the lower terminals, and with the three-pole main switch open, the dynamo can be connected with its own circuit through the two circuit breakers. By reversing the field switches and closing the three-pole main switch, the dynamos are connected in parallel, and any particular circuit can be cut out by releasing its own circuit breaker. The three-pole switch was used to avoid mistakes in connecting up the machines in parallel, which might lead to unpleasant results should the attendant forget to close the equalizer connections first. The actual manipulation is not complicated, as will be readily understood from the following instruction sheet:

(A) All the machines being at rest, to start them up in parallel:

(1) Make sure that the circuit breakers are open.

(2) Close (below) the field switches of the first generator, close the safety switch and start up. When the machine is up to voltage, close the machine circuit breaker, then the three-pole switch. Change the field switch quickly, from the lower to the upper contacts, and close the circuit breakers on the circuits, one after the other. If the machine cannot carry the load:

(3) Close the double-throw field switches of the next machine on to the upper contacts.

(4) Close the safety switch.

(5) Start the machine ahead under full steam.

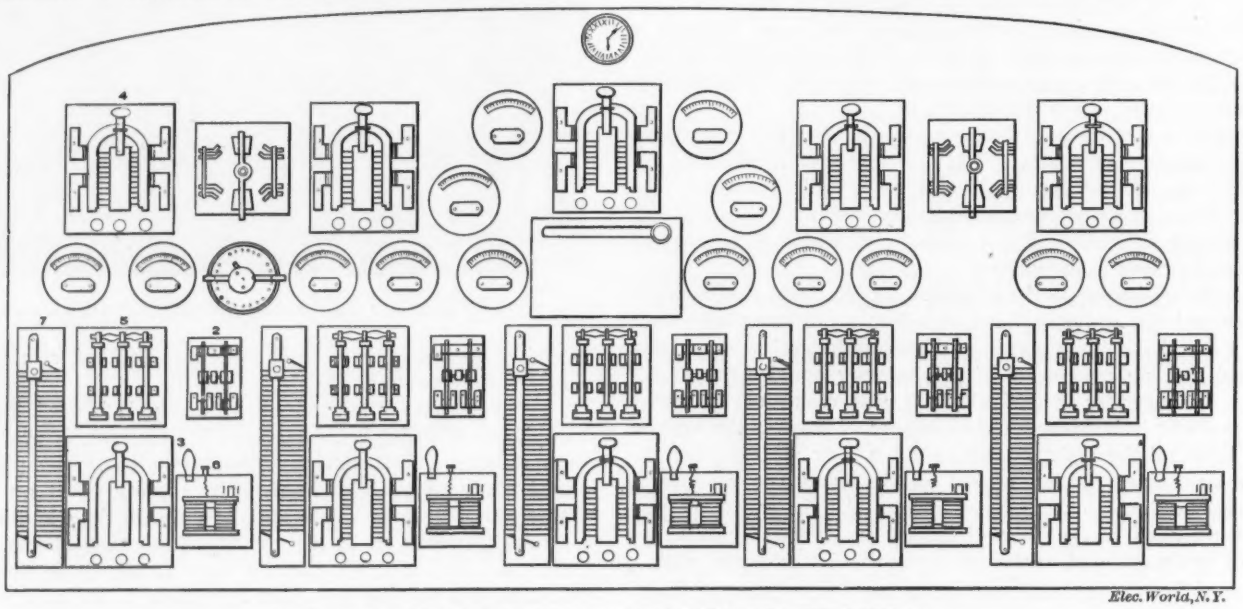


FIG. 4.—DIAGRAM OF THE SWITCHBOARD OF THE SICILIA.

(6) Regulate with the field rheostat of the machine until the voltmeter agrees with the bus bar voltmeter.

(7) Close the three-pole main switch.

(8) Close the machine circuit breaker.

(9) Divide the load on the machine by regulating with the rheostat.

(10) Regulate with common rheostat to keep voltage normal.

(B) To change over into parallel connections when the machines are in operation on their several circuits.

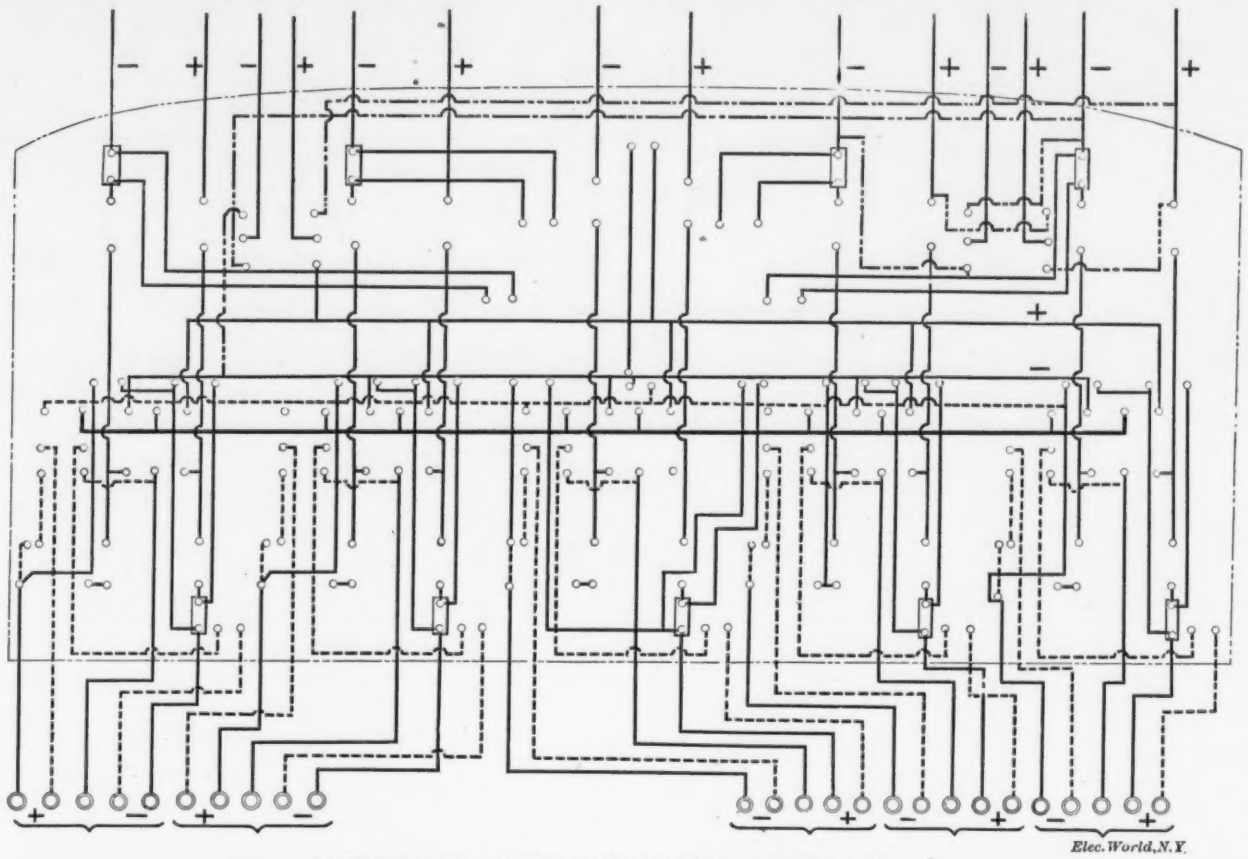
(1) Make sure that the polarity is right.

(2) Close the three-pole switch of the first machine.

(6) Turn on full steam.

(7) Regulate with the individual rheostat until the voltage corresponds to that on the bus bars.

(8) Close the machine circuit breaker.



Elec. World, N.Y.

FIG. 5.—CONNECTIONS AT THE BACK OF THE SWITCHBOARD.

(3) Throw up the double-throw field switch to the upper contacts.

For the remaining machines:

(4) Regulate each individual rheostat until the voltage is the same as that of the bus bars.

(5) Throw up the double-throw field switch.

(6) Close the three-pole switches.

(7) Regulate the loads on the machines with the individual rheostats.

(9) Regulate the load with the rheostats.

(D) The dynamos being in operation in parallel, to stop one:

(1) Diminish the load with the field rheostat.

(2) Open the circuit breaker.

(3) Open the safety switch.

(4) Close the double-throw field switches on the lower contacts.

And if it is intended to cut out the corresponding circuit also:

(5) Open the three-pole switch.

(E) The dynamos being in operation in parallel, to put each one separately on its own circuit:

(1) Close the double-throw field switches on to the lower contacts.

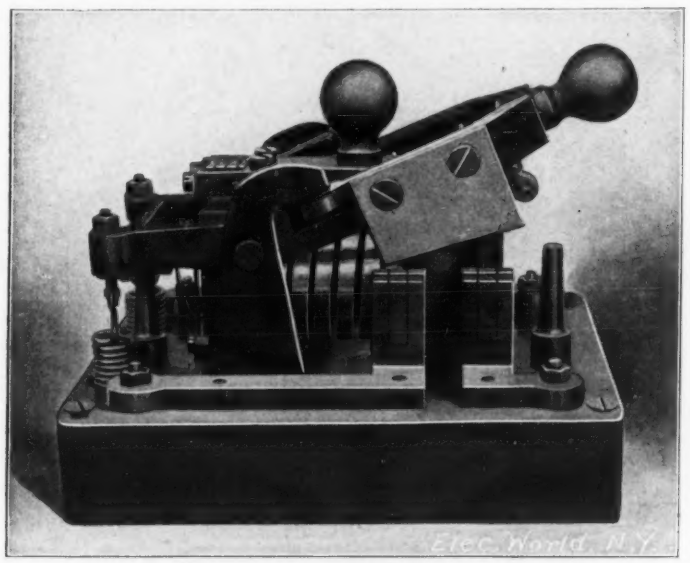


Fig. 6.—Circuit Breaker.

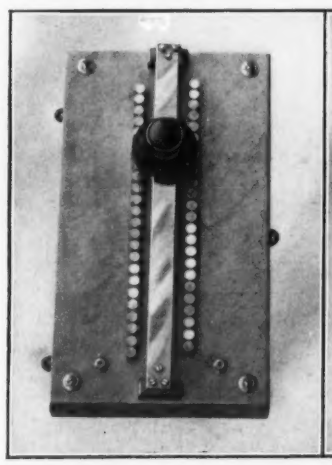


Fig. 7.—General Rheostat.

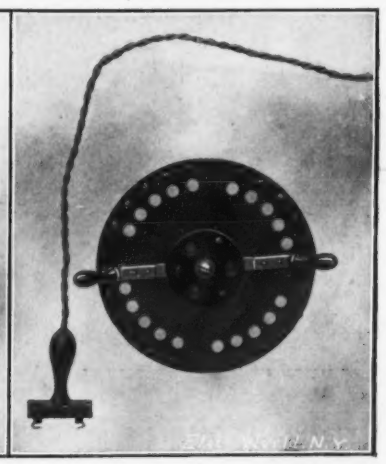


Fig. 8.—Ground Testing Switch.

(C) In case of reversed polarity of a dynamo:

Never change any of the connections.

(1) Open the machine circuit breaker.

(2) Open the safety switch.

(3) Close the three-pole switch.

(4) Throw up the double-throw field switches.

(5) Close the safety switch.

(2) Open the three-pole switches.

(3) Regulate the voltages.

Taken in connection with the foregoing, Fig. 4, which is a diagram of the new switchboard of the Sicilia, needs scarcely any further explanation. The various pieces of apparatus are numbered with the same numbers as in Fig. 3. The diagram in Fig. 5 gives the connections on the back of the switchboard. The cir-

cuits can carry 500 amperes each, but the five machines of 300 amperes capacity each are more than equal to the requirements, as the average maximum load never attains the total maximum possible.

The equipment of this board and the others like it present some interesting features also.

The circuit breakers are double-pole, mounted on cast iron bases, with micanite insulation. They may be set to open at any given load between 200 and 500 amperes. Fig. 6 gives a fair idea of their construction, which is very compact. The arc is extinguished by a magnetic field, and the break occurs simultaneously between four points. If it is desired to cut out a machine or a circuit, the circuit breaker may be released by hand by simply pulling a knob.

The three-pole switches are heavily built, but are not otherwise remarkable; the rheostats for each machine are of the Brush type, consisting of a contact piece, which is made to slide along a wire spiral wound on a piece of slate. The general rheostats (see Fig. 7) are remarkable for the small space which they occupy; the resistance is of some alloy of nickel, imbedded in a non-combustible cement, and can be worked at very high current densities. Round pattern type K and F Weston instruments are used throughout. Notwithstanding the numerous attempts that have been made to imitate them, the Weston instruments are still far and away the best. In Italy a line of very fair instruments, closely resembling Weston's, has been gotten out by the Technomasio, but as the original is indisputably the better instrument, it was the one selected. The circuit and machine instruments are of type K and the bus-bar voltmeters are type F.

Tests for grounds are made by the three-deflection method, with the help of a Weston voltmeter and a switch arranged by M. Leinon for rapidly testing each machine and each circuit. Fig. 8 gives a view of this instrument, and Fig. 9 shows the connections in diagram from which the method of operating it is readily understood. The central hub turns with the handles, bringing two contact springs to bear successively on each pair of contact buttons situated at opposite ends of a diameter. Of the three terminals on the hub, two connect with the contact springs under the handle arms and the third is grounded. The voltmeter is provided with a flexible cord ending in a handle carrying two contact springs, which are to be applied successively to the terminals A B, B C and A C, the

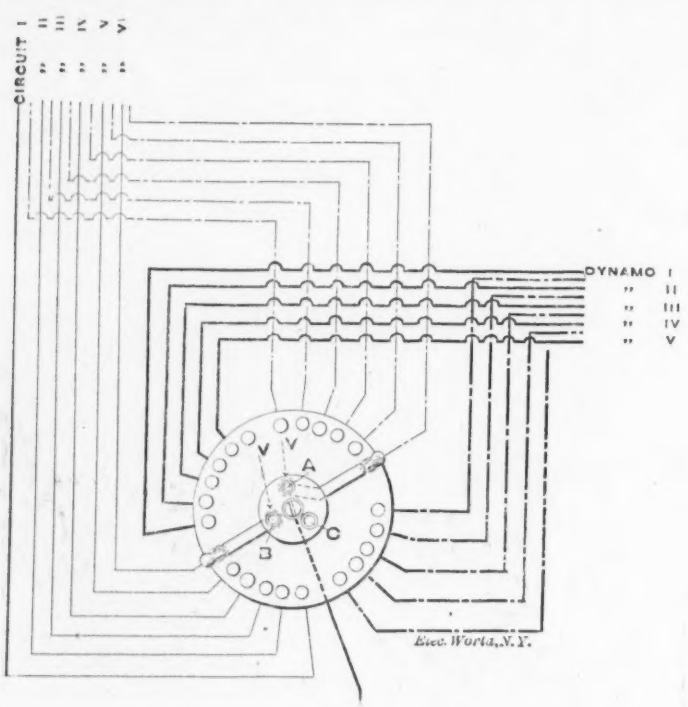


Fig. 9.—Diagram of Connections of Ground Testing Switch.

reading on the instrument being noted. For this work a portable Weston voltmeter is used, type A, every ship having one or two of these instruments, which are kept as standards. They have two scales, one reading from 0 to 3 volts, and one from 0 to 150 volts. The low scale is used for testing batteries, which is done by the aid of a small resistance box specially arranged and shown diagrammatically in Fig. 10.

The cell to be tested is connected with two of the terminals, and the voltmeter with the other two, and the e. m. f. E is noted on open circuit. Then the key closing the circuit through a resistance of 1 ohm is depressed and a second reading, e, is taken. The internal resistance is given by the expression

$$\frac{E - e}{E} = \text{ohms}.$$

The Gassner dry cell was the first one to be used in the navy, but it soon gave way to the Hellesen cell, which was followed by the

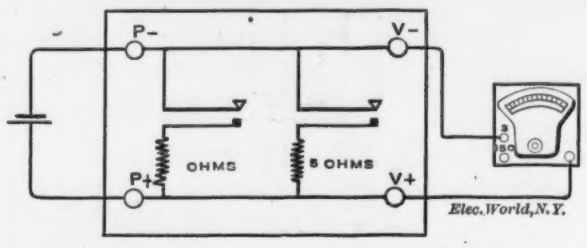


Fig. 10.—Diagram of Arrangement for Testing Cells.

E. C. C. cell; at present the dry cells used are made up in the government laboratories from a formula prepared by the government electricians, and kept secret. Last year experiments were made with a view to suppressing the dry cells altogether, using instead small direct current transformers. A number of these small machines were tested, the most satisfactory being those made by Elliott, of London; Einstein Garone, of Pavia, and the Officna Galileo, of Florence. The latter was one of the very best, being extremely small, entirely ironclad and waterproof; the secondary furnished 200 watts at 12 volts. On open circuit, however, it gave 30 volts and, owing to the relatively large inertia of the armature and the rather high speed, it furnished a very strong kick at the instant of closing the circuit. This effect rendered this machine much the best for the electric detonators of the guns, notwithstanding that its actual capacity was much the smallest.

The electrical firing of guns was not considered to be very successful, so the question of small transformers rather dropped to the ground for want of an object. It had been intended to use them for that purpose chiefly, each group of rapid-fire guns being provided with its transformer. This arrangement would seem to be

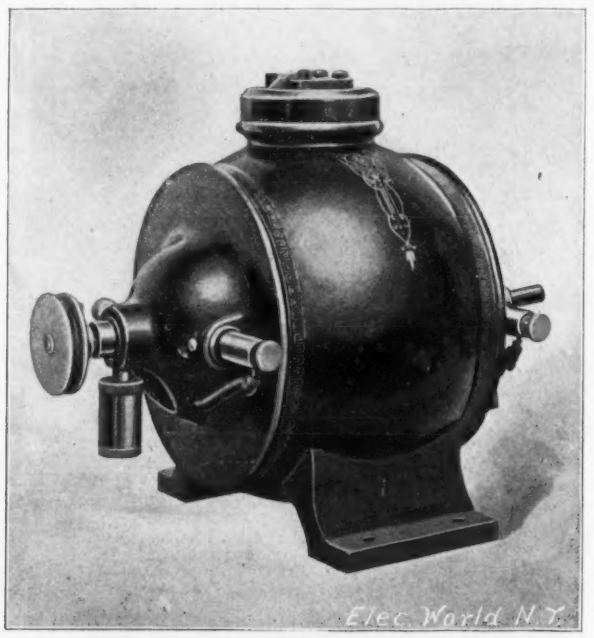


Fig. 11.—Small Direct-Current Transformer.

rather more rational than that which obtains in foreign navies, and on the Argentine cruisers built in Italy, where a special electrical firing circuit is laid and supplied from a single machine in the dynamo room. Our proposed system is less complicated and more reliable on account of the independence of single small transformers. Fig. 11 is a transformer made by Morelli, of Milan, and possessing much the same advantages as the one described above.

Trolley Bridge for the Lewiston Gorge at Niagara.

BY ORRIN E. DUNLAP.

AMONG the immense properties and franchises purchased by the $25,000,000 syndicate which is to be known as the International Traction Company, it is said, is the new suspension bridge across the lower Niagara, above the villages of Lewiston, N. Y., and Queenston, Ont. This bridge is to be built by the Lewiston Connecting Bridge Company, of which William B. Rankine, of New York, is president, and the Queenston Heights Bridge Company, of which Thomas G. Blackstock, of Toronto, Ont., is the head. It will be located on the site of the old Lewiston suspension bridge built in 1851-52, and destroyed by a wind storm on the morning of February 1, 1864. In its general location and lines it will adhere closely to the old structure that was so representative of the early-day enterprise of the Niagara locality, but which was a half century ahead of the demands of the times. In the construction of the new bridge on the old site a tender compliment is paid to the engineering judgment of fifty years ago as to the proper location of a bridge at this point, but the engineers of that time did not then realize that they must await the coming and development of the electrical era before the bridge would be recognized as a necessity for business and pleasure travel.

The new bridge will be a steel structure, and will be erected by the New Jersey Steel & Iron Company. The length of the cable span from tower to tower will be 1040 feet, while the span of the stiffening truss will be 800 feet. From centre to centre of trusses the bridge will have a width of 28 feet, and the roadway will be 25 feet wide in the clear. The stiffening truss will extend about 4 feet above the level of the floor, and the only railings will be light strips of iron flats reinforced by oak half rounds. The floor will be laid with 2-inch oak plank placed crosswise. To connect the suspended span with the river banks there will be two short approach spans, the one on the New York side to be 34 feet 6 inches long, and the one on the Canadian side to have a length of 19 feet 6 inches. The

View of One of the Approaches.

width of roadway, which, as stated, will be 25 feet, will afford facilities for a single track for electric cars, laid along the centre of the floor, with carriageways on either side of sufficient width to allow vehicles to pass. There will be no provision for pedestrians, except the general roadway, the location of the bridge in the gorge being such that it is not expected pedestrian travel will be heavy.

The towers for the bridge were completed last fall. They are four in number, two on each side of the river. The towers on the New York side are about 26 feet high, and have bases 13 feet square. They have been placed about 28 feet back from the edge of the bluff. The towers on the Canadian side are 18 feet high, 12 feet square at the base, and stand 15 feet back from the edge of the bluff, the ledge on the Canadian side being more solid than on the New York side. In the construction of these towers the stone of the old abutments was used in their foundation, while the old inscription stones of the old towers on both sides of the river have been preserved and have been given place in the new work. The new stone used in the New York towers was obtained from the Buffalo quarries and from the Queenston, Ont., quarries for the Canadian towers.

Four cables supplemented with eye bars will be used to support the bridge, and each of these cables will be made of fourteen galvanized cast-steel wire ropes 2¼ inches in diameter. These wire ropes formed the cables of the old upper suspension bridge at Niagara Falls. The cables will be anchored in solid rock about 150 feet back from edge of the bluff, the shafts being filled with concrete. The versed sine of the cables will be 87 feet. The height of the bridge above the water will be 65 feet, and the height of the bridge platform above the tracks of the Niagara Falls & Lewiston electric road will be about 15 feet.

James Stewart & Co. have the contract for the sub-structure. The approaches were practically completed last fall. On the New York side the approach is between the tracks of the Gorge road and the base of the cliff. It is about 800 feet long and 25 feet wide. As it extends along the tracks referred to, an approach wall has been constructed, partly dry and partly laid in cement. This wall is 19 feet high at its highest point and drops at a grade of 1 per cent. for about 600 feet, when the grade for the remaining 200 feet is about 2 per cent. The approach on the Canadian side is about 1000 feet long and about the same width as the New York approach. Double tracks will be laid on both of these approaches to facilitate the passing of electric cars on and off the bridge. A generous growth of vines will be encouraged about these approach walls, and this spring face walls will be built along the cliff side of the New York approach, the effect of these face walls being to prevent the native shale disintegrating under the weather effects. Both approaches extend to the bridge from the north, the approach on the Canadian side being practically the old approach re-excavated.

A Simple Apparatus for Wireless Telegraphy.

BY ELLIOTT WOODS.

The accompanying three sketches show a simple arrangement adopted by me for demonstrations in wireless telegraphy. Heretofore the general purpose has been to provide a suitable tapper for the coherer in order that the metallic particles may be disturbed and the circuit broken. In the arrangement shown the sounder is made to do the twofold work of answering the signals and decohering the

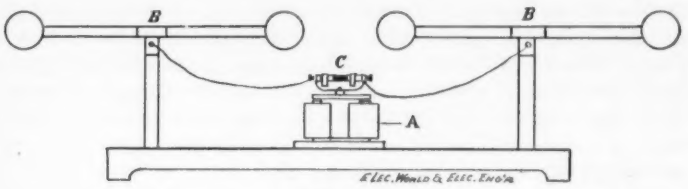


Fig. 1.

metallic filings. I am unaware of any similar arrangement; hence present this one.

Referring to the sketches, Fig. 1 represents the receiving station, which in this case is made up of two "wings" *B B*, whose length is 6 inches each. The knobs used are of 1 inch diameter. The "wings" are supported by glass pillars on a suitable base, on which the sounder *A* is placed. The coherer *C* is a glass tube 2½ inches in length and 5-16 inch diameter, containing suitable terminals connected to the two wings, as shown. The coherer is in series with

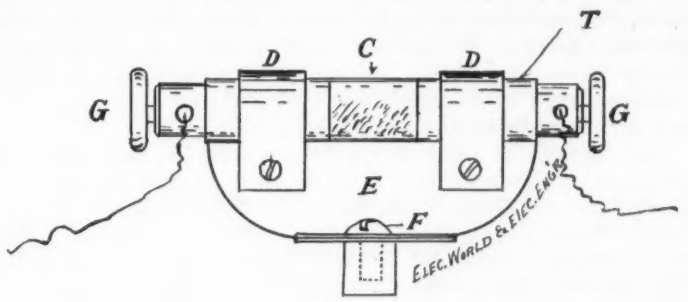


Fig. 2.

the wings *B B*, the relay ordinarily used, and the battery. In practice the wave falls on *C*, the relay closes the circuit of the sounder *A*, and the coherer, being carried on the movable arm of the sounder, is brought down with the arm when the circuit through the sounder is made. In consequence of this, every movement of the sounder arm decoheres the metallic filings, and there is prompt and certain action in response to every signal of the sender.

The construction of the coherer is shown in detail in Fig. 2, and approximately full size. The terminals *G G* are turned down to fit the interior of the tube *C*. The space between (about ⅜ inch) is half-filled with iron filings or lathe cuttings, sifted out through a fine mesh. A hard-rubber block *E* is made with grooved edge to support *C*, which is held in place by brass bands *D D;* a thin brass plate, suitably fastened to the hard-rubber piece *E*, and projecting, provides means for fastening by the screw *F* to the movable arm of

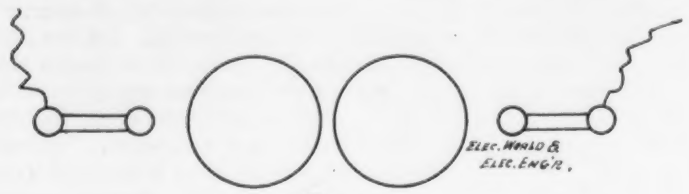


Fig. 3.

the sounder *A*. The best means of doing this is to remove the screw holding the armature of the sounder and clamping by the screw *F* both armature and the fastening plate at bottom of *E*.

The sender, in this arrangement, consists of the usual induction coil discharging into two nickel balls of 4 inches diameter, as shown in Fig. 3. It will be noted from the sketch that there is a triple gap. At each side of the transmitter knobs the gap is 13-16 inch, and the gap between knobs is 3-16 inch.

The arrangement shown has proven all that can be wished for if one does not desire the printing telegraph, as provided for some apparatus.

A Gauge Comparometer.

In a paper read March 22 before the German-American Engineers' Society at Pittsburg, Mr. S. H. Stupakoff described a simple and useful device for comparing different gauges, and serving also for determining standard dimensions, numbers of gauges and other dimensional data, the entire list comprising the following: Brown & Sharpe and Birmingham wire gauges, United States standard gauge for plates, steel music wire gauge, Stubs steel wire gauge, Morse twist drill gauge, American standard screw gauge; number of threads per inch of American standard machine screws; list of tap drills for American standard machine screws; scales of 64ths and 1000ths of an inch; scale of 100ths of a millimeter; scales of weights of copper wire and sheet iron.

The comparometer furnishes the means of comparing any or all of the above data at a glance. The mechanical principle involved is that of a plane spiral base combined with a radius vector, movable around its pole. A shifting of the vector or arm causes some fixed point on it to recede from or to advance toward the spiral, the rate being in direct proportion to the arc traversed.

The pitch of the spiral in this instrument is one-half inch, and the space between the circumference of the base and the adjusting screw of the radius vector or indicator arm gives an equivalent range of measurement. The readings corresponding to the absolute measurements of the comparometer caliper are tabulated on the base, and they are found, in each instance, in a radial line with the micrometer screw along the beveled edge of the indicator arm. The latter bears the descriptions for the divisions on the base and a vernier for the inch scale. The indicator arm is equipped with an adjusting screw in the same plane with the spiral edge of the base, and at right angle to its tangent.

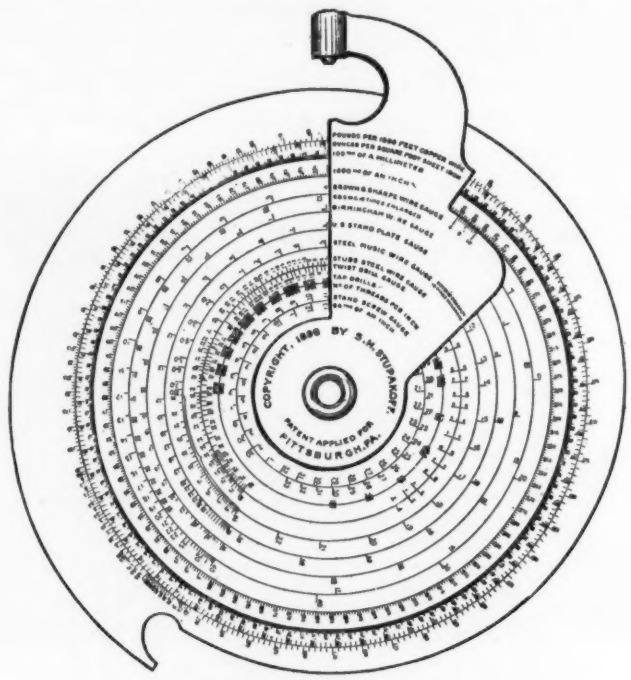
The divisions on the base are described on the indicator; they represent in all cases a limit between 0 and ½ inch for the whole revolution. All numbers relating to the divisions on the base are marked above their respective division lines, which facilitates their rading without shifting the indicator. The inch circle, being divided into 500 equal parts, represents five hundred one-thousandths, or each of its divisions one one-thousandth of an inch. Intermediate divisions can be read off with ease on the vernier belonging to this circle; with its aid direct readngs to one ten-thousandth of an inch can be obtained. The metric circle gives direct readings from 0 to 12.7 millimeters in hundredths of a millimeter.

The Brown & Sharpe wire gauge circle is provided with double divisions. The divisions on the outside of the circle are in direct proportion to the inch and the metric circle. The divisions on the inside, however, are tenfold enlargements of the former; they add, therefore, another decimal to the inch and metric scales, when compared therewith. For instance: No. 40 B. & S. wire gauge on the outside of the third circle is read with the aid of the indicator .003 inch on the inch circle, and the vernier gives an additional reading of .0001. The same number wire gauge on the inside of the circle is read on the inch circle .0031, while the vernier gives an additional figure, .00004. These finer readings, however, being only important for the smallest sizes of wires, do not run beyond the limit of .05 inch.

The Stubs steel wire and the twist drill gauges, being nearly alike, are marked on one common circle, the one outside and the other inside of the same. The gauge lines and numbers of the American standard screw gauge are placed on the outside of the smallest circle; their corresponding dimensions or diameters are found radially in line therewith on either one of the scale circles; the number of threads to the inch and number of tap drills occupy the space on both sides of the second smallest circle. This gives all information necessary relating to American standard machine screws.

The division on the inside of the smallest circle gives relative values of the above dimensions in 64ths of an inch. The division on the outside of the largest circle gives the weight of 1000 feet of copper wire in pounds avoirdupois, and the division on the inside of the same circle gives the weight in ounces for each square foot of sheet iron. (Copper of 8.89 specific gravity weighing nearly 555 pounds per cubic foot; iron of 7.69 specific gravity, weighing 480 pounds per cubic foot; water at its greatest density being 62.425 pounds per cubic foot.)

A single example will sufficiently explain its working. Let us assume we have a piece of copper wire, of which we would like to



Gauge Comparometer.

find out all possible data. We bring it between the spiral edge of the instrument and the micrometer screw and, looking along the straight edge of the indicator for the number of wire gauge, we find it to correspond exactly to

No 4 B. & S. wire gauge.

Radially in line therewith and beginning nearest the centre we find further the equivalents for this number in the following order:

13-64 inch,
No. 11 Standard Machine Screw,
24, 28, or 30 threads per inch,
No. 21, 20, or 19 Tap Drill,
No. 26 Twist Drill Gauge,
No. 5 Stubs Steel Wire Gauge,
No. 6 B. Wire Gauge,
.2043 inch,
5.19 millimeters,
Equals 126½ lbs. per 1000 feet (copper wire).

The reverse side of the disc contains scales whereby the weight of wire per 1000 feet and of plates per square foot may be read off for a number of different metals.

Independent Telephone Meeting at Cleveland, Ohio.

THE Ohio Independent Telephone Association held a convention at the Hollenden, Cleveland, on March 15 and 16. It was well attended.

Reports at the meeting developed that there were 121 independent telephone exchanges now in actual operation in Ohio, and about 2500 miles of local toll lines. The need of first-class long-distance toll line connections was freely commented upon, and a unanimous expression was given of the necessity of this business being carried on under the management of one strong company to connect all the independent exchanges and local toll lines now in existence and afford facilities for interstate communication by means of connection with long-distance toll lines now being built in all the adjacent States.

This want, it was said, will be supplied during the coming year by the United States Telephone Company, with headquarters at Cleveland, which has already contracted for the material for more than 2000 miles of pole lines, and this work will be prosecuted and connections made with different independent exchanges and local toll line systems under contracts already signed by the majority of independent exchanges. It is claimed that within a year all the independent exchanges in Ohio will be connected by means of the United States Telephone Company's metallic circuit lines.

During the second day's proceedings, Mr. S. P. Sheerin, of Indianapolis, gave a comprehensive talk on long-distance telephones. He spoke of the independent company's work at Indianapolis, and said long-distance companies were essential to the local independent companies.

J. B. Hoge, of Lorain, talked of the United States Long-Distance Telephone Company and its object. He said his company expected to build 2000 miles of toll lines and to connect with all points of any importance in the State. His company will spend this summer $750,000 in extending its lines over the State.

Thomas Fricker, of Ashtabula, spoke upon "Mutual Obligations." He advocated a similar construction over the State, and that the best. He referred to the Bell people as the "common enemy." He said the independent people should canvass for subscribers as the Bell Company is doing. The one thing that was important was the "telephone girl." He said the "telephone girl" could either "make or break up" an exchange. The girls should not be allowed to crochet or make fancy work while on duty. He also said a sufficient number of girls should be employed to guarantee efficient service.

Just before the noon recess of the meeting of the independent telephone companies the committee on revision of the constitution submitted its report. A number of important changes were recommended and adopted.

The offices of secretary and treasurer were merged, and the official who performs these duties will receive a salary of $200 per year. The president's salary of $100 a year was abolished, and the position will not carry any compensation. The time for the semi-annual meetings was changed from the second Tuesdays of January and July to the first Tuesdays of these months.

The membership fee was reduced from $15 to $5. The annual dues for companies operating 100 telephones or less was reduced from $10 to $5; for companies carrying 100 and not more than 200, the dues were reduced from $15 to $7.50; for companies operating over 200, the annual dues will be $10, instead of $25.

At the afternoon session a short speech was made by J. B. Hanna on behalf of the United States Long-Distance Telephone Company. Mr. Hanna stated that the company was anxious to extend its lines through the State, and asked the various independent companies represented in the exchange association to co-operate. Mr. Hanna was given assurance that the independent companies are willing to connect their lines with the United States Long-Distance Company. The plan is to place subscribers of the independent companies practically on a long-distance line by connecting the local exchange with the United States Company's service.

The United States Telephone Company, of which Henry A. Everett is one of the principal stockholders, will accordingly control the independent long-distance telephone business in Ohio.

At the afternoon meeting the name of the association, by vote, was changed from the Ohio Telephone Exchange Association to the Ohio Telephone Association.

Officers were elected as follows: President, Judge James M. Thomas, of Chillicothe; vice-presidents, Kora F. Briggs, Tiffin; Edward Kibler, Newark; Amsey Whitney, Mt. Gilead; secretary-treasurer, M. D. Critchfield, Mt. Vernon. Members of the executive council: E. L. Barber, Wauseon; J. B. Hoge, Cleveland; D. J. Cable, Lima; W. H. Butler, Kent; H. J. Barnes, Warren; A. R. Warner, Wellington, and Thomas Fricker, Ashtabula.

There were present at the meeting: From Indiana, Hon. Simon P. Sheerin, president of the New Long-Distance Telephone Company, of Indiana, and Samuel M. Foster and George W. Beers, of Ft. Wayne; from Michigan, Hon. E. B. Fisher, president of the Home Telephone Company, of Grand Rapids, and Hon. R. F. Johnson, president of the Saginaw Telephone Company, of Saginaw; and from Kentucky, W. B. Seaton, of Ashland. Among those present from Ohio were the following: Kora F. Briggs, secretary and manager Home Telephone Company, Tiffin; W. M. Hesteltine, director Citizens' Telephone Company, Delaware; M. H. Brinkerhoff, secretary Upper Sandusky Telephone Company; H. J. Curtis, director Sandusky Telephone Company, Sandusky; Leon S. Hubbell, Chagrin Falls Telephone Company; Horton Park, secretary Kenton Telephone Company; H. J. Barnes, manager Warren and Niles Telephone Company; R. E. Connelly, secretary New Harrison Telephone Company, Toledo; J. Heter, president Huron County Telephone Company, Monroeville; A. B. Conklin, director Warren and Niles Telephone Company; J. A. McLean, director Citizens' Telephone Company, Washington C. H.; W. B. Seaton, president Lawrence Telephone Company, Ironton; C. H. Corey, director National Telephone Company, Lima; P. H. Hubbell, manager, Chagrin Falls Telephone Company; J. R. Swartz, manager Star Telephone Company, Ashland; V. W. Peck, vice-president Morrow County Telephone Company, Cardington; A. A. Whitney, president Morrow County Telephone Company, Cardington; Percy J. Smith and E. L. House, Painesville Telephone Company; D. A. Yoder and C. E. Yoder, Northern Ohio Telephone Company, New London; H. E. Graham, manager Norwalk Telephone Company; W. R. Burkdull, manager Ohio Telephone Toll Line Company, Norwalk; A. Y. Gordon, manager Farmers' Telephone Company, Massillon; Solon C. Thayer, manager Newton Falls Telephone Company; Will W. Morrison, Bryan Telephone Company, Bryan; James G. Palmer, secretary and manager Conneaut Telephone Company, Conneaut; Thomas Fricker, president Ashtabula Telephone Company, Ashtabula; Fred J. Bollinger, Port Clinton Telephone Company, Wauseon; E. G. Laughlin, secretary Carey Electric Telephone Company, Carey; James H. Thomas, Home Telephone Company, Chillicothe; George Adams, president Millersburg Telephone Company; S. C. Kissner, secretary Farmers' and Merchants' Telephone Company, Warsaw; C. F. Moore, the Interstate Telephone Company, Cleveland; Jos. S. Bailey, president Montpelier Telephone Company, Montpelier; H. Marvin, secretary Urbana Telephone Company; C. D. Juvenall, secretary London Telephone Company; Ed. L. Barber, Central Construction Company; Wauseon; B. L. McElroy, Frank L. Beam, P. S. Kelser, H. D. Critchfield, Mt. Vernon; B. H. Evans, Youngstown Telephone Company; Edward Kibler, Newark Telephone Company; Charles E. Stasel, Newark; Harry Devin, Mt. Vernon Telphone Company; Hoyt Ford, Mansfield; Bert Hubbel, Cleveland; A. R. Warner, Wellington; J. W. Lowe, Mentor; S. E. Mayen, Millersburg; A. V. Hageman, Lorain; A. B. Taylor, F. L. Fuller, Elyria; E. P. Johnson, Oberlin; John C. Bolinger, Clyde; J. M. Hart, Collinwood; James S. Bradley, Jr., Wauseon.

The New York Telephone Bills.

AT a hearing before the Legislative Committee on Miscellaneous Corporations, at Albany, on March 14, Mr. U. N. Bethell, general manager of the New York Telephone Company, made an argument against the proposed bills to regulate telephone rates. The principal bill before the committee is that introduced by Senator Marshall, which fixes a flat rate of $125 a year for New York and various other rates for smaller towns. The only persons who appeared in support of the Marshall bill were several members of the New York Board of Trade and Transportation, and of the Merchants and Manufacturers' Board of Trade, among them being Mr. Silas Giddings, Mr. Waldo Smith and Mr. Frank Gardner, of the People's Telephone Company.

In the course of his argument Mr. Bethell said that in regard to telephone development New York stands in the very foremost posi-

tion among great cities. Nowhere else has so much been done to supply the public with adequate and efficient telephone facilities at reasonable rates. The grounded circuit system had been replaced years ago by the metallic circuit; pole lines had been taken down and an extensive system of underground cables substituted; every subscriber's station was supplied with the best equipment known to the art, and the central offices had been periodically rebuilt as improvements in apparatus were invented. Changes are now going on, which will eventually be extended to the whole system, intended to effect a considerable improvement in the service, made possible by very recent inventions. Coincidently with these radical and sweeping improvements in the plant, involving the complete reconstruction of the system, extensive reductions had been made in the rates by the adoption of the message rate method of charges, and these reductions had been so well appreciated by the public that the number of stations had increased from less than 10,000 in January, 1895, to over 28,000 in March, 1899, a gain of nearly 200 per cent. in a little over five years. This gain was proceeding at a rapidly increasing rate even while the bills to regulate telephone charges were being agitated, showing that the public is reasonably satisfied with the present scale of rates.

The remarkable development of telephony in New York, both from a technical and a business point of view, appealed, he said, to telephone experts all over the world. During the past year officials from the British Government Telegraph Department, from the National Telephone Company of Great Britain, from the Stockholm General Telephone Company, from the French Government Telegraph Department and from the Imperial Japanese Telegraphs had visited New York with the object of inspecting its telephone system, and of acquainting themselves with its technical features and with the wonderfully successful message rate system which had produced an increase of subscribers unapproached in other great cities. The Secretary of the British Treasury, who has no doubt studied the reports of the Government experts who visited New York, stated to Parliament a few days ago that it was notorious that the United Kingdom was far behind the United States in the development of telephony. Mr. W. H. Preece, the engineer-in-chief of the British Post Office, and Mr. W. E. L. Gaine, the general manager of the National Telephone Company, both stated in their evidence before the recent telephone committee of the House of Commons that the message rate system was the correct method of charging for telephone service, and both referred to the successful experience of New York.

The supporters of the bills under consideration always spoke of the $240 flat rate as if it were the only rate for telephone service in New York. As a matter of fact the $240 rate had never been paid by but a proportion of the subscribers, and at the present time there were only 10 per cent. of the total number of stations taking service at the $240 rate. Since the introduction of the message rates, striking reductions had been made in the cost of service to the public. The majority of subscribers had taken advantage of these reductions and had changed from flat rate to message rate, while the numerous new subscribers who had come on during the past few years had practically all come on at the low message rates, so that, as stated, at the present time, only 10 per cent. of the total stations were $240 flat rate stations, and the average rate of the whole system was considerably below the flat rate of $125 which the Marshall bill seeks to impose.

Mr. Bethell further pointed out that the fixing of a maximum rate would destroy one of the essential features of the message rate system by restricting the principle of payment in proportion to service rendered. If the maximum were dragged down, the minimum would have to be lifted up to meet it. This defect had already been pointed out by one of the supporters of the bill, and it was one of the strongest arguments against the bill. The company's natural desire was to extend the benefits of the message rate system by lowering the minimum so as to reach wider classes of telephone users. This had been demonstrated several times by successive reductions of the minimum rate since the first introduction of the message rate plan. If, however, an arbitrary maximum rate were imposed, further reductions in the minimum rate would become impossible and a period of enforced economy would ensue which would result in detriment to the service and inconvenience of the majority of telephone users.

In connection with this point it was important to notice that the principal supporters of the Marshall bill were the officials and advisers of a corporation organized to enter into competition with the New York Telephone Company. Mr. Gardner, the exponent of the views of the People's Telephone Company, had stated through the daily papers that his company would have in New York a plant completely equipped for 50,000 subscribers ready for operation by October, 1899, and the same Mr. Gardner was a strenuous supporter of the Marshall bill to fix a maximum rate of $125 for telephone service in New York, and to empower a commission to compel the New York Telephone Company to make public all its business management. It was strange to find the Legislature being used thus openly to assist a business competitor against a rival whose position was to be attacked. The establishment of a legal maximum rate of $125 for telephone service in New York would cut in two the revenue from a class of customers which the People's Telephone Company could not hope to attract in the beginning, and might never obtain at any time—the large users, the people who use the telephone all day long to call up others scattered all over the city. The small users, the class from which the larger proportion of the New York Company's subscribers is recruited, and which the People's Company might appeal to, are left alone. This proposition was a very simple and ingenious one from the point of view of the business competitor who urged it, but its practical application ought not to be lost sight of by those whose calling it is to legislate for the general good. If the New York Company were compelled to serve its large users at a loss, it would naturally have to charge its small users more than at present or economize in the service, or both. In any case its business would be injured, and all possibility of extending it by further modification of the message rate plan toward a lower minimum rate would be precluded. A new company would naturally cater at first entirely to small users, and would not be so hampered.

New Indiana Laws Affecting Electrical Interests.

During the last session of the Indiana Legislature, which closed on March 6 last, several new laws were enacted affecting the various branches of the electrical industries in that State. An abstract of these laws is given below, as a valuable indication of the trend of legislation bearing upon electricity:

Tampering with Electric Light Property and Apparatus.—A law providing that whoever unlawfully and intentionally injures, destroys, or permits to be injured or destroyed, any meter, pipe conduit, wire, line, post, lamp, or other apparatus belonging to an electric light and power company or intentionally prevents any meter from registering the quantity of electricity furnished, or unlawfully and intentionally diverts any electric current from a wire belonging to such company, or uses its electricity without its consent, shall be fined not more than $100, or imprisoned not longer than one year, or both.

Telephone Companies.—A law amending section 4184 of the Revised Statutes, 1881, so as to remove the limit on the number of directors that may be elected by the stockholders of a telephone company, providing simply that they shall elect not less than three directors. It also adds the requirement that all directors elected shall be bona-fide stockholders of the company.

Heating of Street Cars.—A law requiring that every street car must be comfortably heated by electricity or otherwise each winter from the 1st of November to the last of March. A failure to comply with the law subjects the company and its officers and agents to a fine of from $25 to $100 for each day its cars are not properly heated.

Consolidation of Lines.—A law providing for the consolidation of two or more street railroad companies whose roads together form a continuous line. The law makes special provision for consolidation with a street railroad running to the State line, and for the joint operation of a street railroad by a corporation of this State, and one owning a track in an adjoining State. This law takes effect immediately.

Ft. Wayne Suburban Lines.—A law amendatory of the general street railway law so as to require the street railroad of Ft. Wayne to permit suburban lines to use its tracks on the same terms that were formerly imposed on street railroads in Indianapolis. The law, however, does not undertake to preserve the rights of suburban street railroads in Indianapolis.

Indianapolis Suburban Lines.—A law amending the law of 1891 so as to give control over the question whether suburban railroads may use the tracks of the down-town companies in the city of Indianapolis into the hands of the Board of Public Works and the

Common Council, instead of the Aldermen and Council. It gives a suburban company the right to use the other company's tracks from the time of filing an action to condemn such right; requires the latter company to provide a loop for turning cars at the central point to which the suburban road runs; permits the suburban company to string wires on the city company's poles, if the latter cannot furnish it with power, and omits the provision that the suburban company shall not run more than 10 miles into the country. (Doubts are expressed as to the validity of this act, because it is a sort of a substitute for an act passed earlier in the session.)

Special Street Railway Law for Indianapolis.—This is a new law applying only to the city of Indianapolis. The law authorizes the city to contract with any street railroad company organized after the census showing Indianapolis to have more than 100,000 inhabitants was taken, for a surrender of all its existing franchises and the grant of a new franchise to operate a street railway in the streets of the city for a period not longer than thirty-four years. The fare cannot exceed 5 cents for a single ride, with privileges of transfer, and tickets must be sold at the rate of six for 25 cents and twenty-five for $1. A persistent violation of the provisions of the act, or of the ordinance passed by the Common Council, pursuant to the act, will subject all the company's rights in the streets to forfeiture. The company must permit the use of its tracks by suburban railways from the corporation line to the central point. All the company's rights shall absolutely terminate at the expiration of thirty-four years, or the period named in the contract with the city. At the expiration of the franchise so granted the privilege of occupying the streets for a further period of not more than thirty years, on terms to be prescribed by the city authorities, shall be offered to the highest bidder. This law takes effect immediately, and is intended to enable the city to settle the vexatious street railway question. The Governor allowed the bill to become a law without his signature.

CURRENT NEWS AND NOTES.

An Apostate.—First Trolley Motorman (with disgust)—Well, what d'yer tink of Crasher, who used to run 74? Second Do—Why? First Trolley Motorman (witheringly)—He's gone and jined de life-savin' service.—Philadelphia "North American."

To Enlarge a New York Telephone Building.—The New York Telephone Company has bought the property at No. 14 Cortlandt street, adjoining its present building at No. 18, paying therefor $200,000. The building just purchased will be torn down to make room for a 12-story addition to the telephone company's present quarters.

Using the Telephone to Cover Up Peccadilloes.—An ex-officer of the New York Custom House was fined $1000 a few days ago by Judge Thomas in the United States Criminal Court for having presented a false voucher for $3.85. This amount, which was really expended in drink and cigars, was charged to the telephone account.

Electro-Chemistry.—In a presidential address recently delivered before the French Société des Ingènieurs Civils, M. Dumont dwelt upon the vast advances made during the past ten years in electro-chemistry. At present there is utilized in that industry electrical energy to the amount of 80,000 horse-power in Switzerland and 20,000 horse-power in France, the United States being credited with 60,000 horse-power.

Sand to Extinguish Fire.—Sand will be used to extinguish fire if there should be one in the New Telephone Company's exchange at Indianapolis. It is used because it is less injurious to the electrical apparatus than water or chemicals would be. The sand is stored in a large tank above the exchange room, and is sifted automatically to any or all parts of the building in such a manner as to smother out fire very effectively.

Prof. Elihu Thomson will lecture on March 29, at 8 P. M., before the New York Electrical Society, on the subject of "Electricity at High Pressures," accompanied by experimental demonstrations with new apparatus. The meeting will be held at the house of the Society of Civil Engineers, 220 West Fifty-seventh Street. Secretary Guy should be notified at once by all who desire to attend.

To Ventilate the Hoosac Tunnel.—What will be one of the largest ventilating fans in the world has been ordered for the purpose of ventilating the Hoosac Tunnel. The fan will be 16 feet in diameter and 8 feet wide, and will be driven by an electric motor. It will have a capacity of drawing 600,000 cubic feet of air per minute, and when it is in operation it will clear the smoke, gas and impure atmosphere from the tunnel. The clearer atmosphere in the tunnel will enable the trains to attain higher speeds.

Electricity in the Household.—There will be opened June 1 in Brussels an exposition of the applications of electricity in the household, under the auspices of the Société Belge des Electriciens. The exhibition will be held in the new Hôtel de Téléphone, a magnificent building, and will be open for exhibits from foreign countries. It will cover all of what may be called household application of electricity, including hygiene, comforts, æsthetics, cooking, etc., "coquetterie" being even assigned a department.

Rich from Wire Cutting.—A man said to have grown rich from wire cutting was captured outside St. Louis, Mo., a few days ago. He was driving in a buggy, and 50 pounds of copper wire were found in his possession, which was identified as wire that had been clipped from the American Telegraph & Telephone Company's lines a few minutes before. In his room were found all the appliances of a professional wire cutter, such as clippers, climbers, etc. Two sets of policemen have been watching for the alleged clipper along one of the roads upon which he had been located, so that he could not escape.

The Price of Calcic Carbide.—In a recent communication to the French Société des Ingenieurs Civils, M. Houbou stated that calcic carbide is now sold at Alpine factories for $70 per ton. He called attention to the fact that, while freight from these factories to Paris amounts to $24 per ton, calcic carbide from the United States is delivered in Europe at a cost not exceeding $6 per ton for ocean freight. He said that commercial carbides are of diverse qualities, some giving as high as 300 litres of acetylene per kilogram, and others as low as 250 litres.

The Gramme Company in France.—The old Gramme Company, which was founded as early as 1872 under the name of La Société des Machines Magneto-Electrique Gramme, has been reorganized under the name of Société Gramme. This company has received a contract to furnish power for operating the electric railway, which will be installed within the grounds of the exposition of 1900, and also a movable platform between the Esplanade des Invalides and the Champs de Mars. Three-phase currents will be generated at high voltages, stepped down, transmitted at high voltage and stepped down at rotary converters, which will feed direct into the mains.

Automobiles in Paris.—Members of the Society for the Prevention of Cruelty to Animals ought to rejoice, it is said, for Paris in a year or two will no longer be called the hell of cab-horses, at least. Next month the General Company of Vehicles will send out 110 electric automobiles, the number being increased as other cars are ready. It is expected that during the exhibition year over 1000 motor cabs and hackneys will be running, and that by degrees the 3500 fiacres or sapins now in use will be suppressed. The new cabs are to be supplied with accumulators capable of working over about 37 miles without need of replenishment. Four kinds of vehicles are to be put in circulation.

Electric Railway Projects in Indiana.—To demonstrate that Indiana, so rich with natural gas facilities, is also entering upon an electrical era one need only read the following list of the electric roads in Indiana that are either being built or for which plans have been made. The list includes electric lines from Evansville to Tell City, Camelton and Rockport; from Muncie to New Castle; from Muncie to Anderson; from Richmond to Eaton, Ohio; from Richmond to Muncie, connecting intervening towns; from Aurora to Rising Sun; from Garrett, connecting Auburn, Waterloo, Ashley, Hudson, Pleasant Lake, Angolia and Fort Wayne; from New Castle to Indianapolis; from Fort Wayne to Indianapolis; from Indianapolis to Logansport; from Indianapolis to Plainfield; from Indianapolis to Greenfield; from Indianapolis to Martinsville; from Middletown to Danville; between Muncie, Hartford City, Eaton, Shiedler, Albany, Dunkirk and Candeen, and from Columbus to Terre Haute. Other lines are projected, but have failed to give any indication of being actual or of sufficient vitality to bring results.

Prof. J. R. Commons, who has been an active writer in favor of the municipal ownership of electric lighting plants, is to retire from the faculty of Syracuse (N. Y.) University. Among the reasons are said to be his leanings to Bryan, free silver, socialism and State management of everything.

Mr. H. H. Harrison, for a long time past associated with the J. G. White Company, has just been elected treasurer of the Lotos Club, one of New York's most famous social organizations. Mr. Harrison is chairman of the executive committee of the New York Electrical Exhibition Company, and well known throughout the country in connection with electrical engineering work.

Municipal Ownership in Chicago.—On March 14, by a vote of 50 to 2, the Chicago city council went on record as being in favor of the municipal ownership of gas and electric lighting and heating plants. It should be said, however, that the matter was not discussed, and it was believed the average alderman voted in favor of the proposal on the general ground that it was largely buncombe, and would never amount to anything.

Telephoning a Tramp.—In New Albany the other day, says the North Vernon (Ind.) "Republican," a lady saw a well-dressed man call at the house of a neighbor. Through her telephone she inquired of the neighbor if the visitor was not a "respectable" tramp, and was informed that he was. She then stated the case through the telephone to her neighbors, and when the tramp called later on to levy contributions he found a woman with a broom waiting for him. He left that section—and great is the telephone.

The Germain Telephone.—A special dispatch from London of March 18 says: An engineer named Germain in the French Ministry of Posts and Telegraphs has just brought out an invention which he claims will revolutionize the telephone. By an ingenious adaptation the microphone is made to develop and intensify the vibration received, so that it is unnecessary to place the receiver to the ear or stand with the mouth close to the transmitter, and conversation is easily carried on between two persons, both of whom may be several yards distant from the instrument. The invention has been several times officially tested, and pronounced a complete success.

Combination in Washington.—It is announced that the sale of the Metropolitan and Columbia Street railroads of this city, which has been pending for several months, has been completed. This is the largest transaction of the kind that ever occurred in Washington, involving, in the case of the Metropolitan Company, the payment of something like $4,000,000, and in that of the Columbia of over $1,000,000. But this sale is said to be but the first step in an immense combination which will include the two electric light companies of the District, the gas companies of Washington and Georgetown, and all the street railroad lines save those of the Capital Traction Company and the old Washington and Georgetown. The capital stock of the combined orgaization will be $25,000,000 or $30,000,000.

Cape-to-Cairo Telegraph.—A special London dispatch of March 18 says: If one Englishman has been loathed and distrusted in Berlin more than another since the Jameson raid that man has been Mr. Cecil Rhodes. He was to the Germans the archetype of the unscrupulous millionaire, a bully tolerated by British Ministers because he did their dirty land-grabbing work for them, and often paid for it out of his own pocket. To-day he leaves Berlin with an agreement in his pocket, signed, sealed and delivered, for the passage of his Cape-to-Cairo telegraph across German territory, with the promise of the German government's guarantee for that part of his Cape-to-Cairo railway, which also goes through German territory, and with a signed photograph of the Kaiser as a token of personal friendship.

William Thomas Jaggers, thirteen years old, a special messenger of the American District Telegraph Company sent by Richard Harding Davis from London with a letter to this city, another to be delivered in Philadelphia and a third addressed to Chicago, arrived in New York on Saturady last on the American liner St. Louis. He was met at Quarantine by representatives of the New York office of the telegraph company and by Charles Davis, a brother of the novelist. As soon as the steamship was docked Mr. Davis and Jaggers entered an electric cab and went to his first destination. Jaggers is small for his age. He is a bright little chap, and is known at home as Messenger 757. The boy was sent by the novelist in an effort to beat the Postal Union mail service, as noted in these pages last week.

Municipalism at Crawfordsville, Ind.—A special dispatch of March 15 to the Indianapolis "News" says: More rottenness is being unearthed by the investigating committee of the city council. Last week it developed that a number of city employees were supplied with telephones for which the city paid, and last night it came out that a number of others are supplied with free service by the management of the city electric light plant. All those connected with the plant are said to be using the light without price, whereas the management began to refuse pay applicants the service some time ago, on the ground that the plant was already loaded to its carrying capacity. It now develops that every employee of the plant has his house wired and is using all lights desired. The exposé has caused a breeze of indignation, and the superintendent has been ordered to cut off all deadhead service at once. The investigation will be carried to other municipal departments.

The Convention of the American Street Railway Association.—Arrangements have been completed for the holding of the eighteenth annual convention of the American Street Railway Association in Chicago, beginning on October 17 next. The meetings will be held at Tattersall's, State and Sixteenth Streets, and the exhibition of supplies and apparatus will be held in the same building. Tattersall's is the largest exposition hall in the city, and has an abundance of floor space, light, heat and power. The meetings will be held on the second floor of the exhibition hall. Applications for space should be made by September 1 to Mr. James R. Chapman, 444 North Clark Street, Chicago, who is chairman of the committee on exhibits. Assignments will be made as promptly as possible after that date. It is the intention to group exhibits of a like character. The headquarters of the association will be at the Auditorium Annex, and the annual dinner will be held in the same place on the evening of October 20. Railroad tickets to Chicago will be sold on the certificate plan in the usual manner.

Convention of Railway Telegraph Superintendents.—A partial list of the papers to be read at the convention of the Association of Railway Telegraph Superintendents, which will be held in Wilmington, N. C., on May 17, is as follows: "Highway Crossing Alarms," by George C. Kinsman, superintendent of telegraph of the Wabash Railroad; "Proper Protection to Buildings, Instruments, etc.," by J. C. Barclay, electrician, Western Union Telegraph Company, Chicago, Ill.; "Telegraph Construction and Maintenance," by C. H. Bristol, superintendent construction Western Union Telegraph Company, Chicago; "Electric Light Plants for Railroad Offices and Yards," by C. F. Annett, assistant superintendent of telegraph, Illinois Central Railroad, and "Telegraph and Telephone Systems Combined," by Charles Selden, superintendent of telegraph, Baltimore & Ohio Railroad. Mr. Thomas D. Lockwood, of Boston, will also read a paper, the subject of which, however, has not yet been announced. In addition to these papers it is expected that others will be presented and read. The committee on "Low Resistance Relays" will report on its work during the past year.

Brooklyn Railway Changes.—It is understood that President Borne and Vice-President Hugh J. Grant, of the Nassau Electric Railroad Company, who were recently elected to serve temporarily in the interest of the syndicate headed by Roswell P. Flower when that syndicate purchased the road, will shortly resign their offices and will be succeeded by Clinton Rossiter and Harry C. Duval. The electric power plant of the Nassau Road at Thirty-ninth Street has been closed up, and the power for both the Nassau and Rapid Transit systems is now being furnished by the two other power houses owned by the Rapid Transit Company. The closed plant may, however, be operated during the heavy traffic in the summer season. Frederick Uhlmann, the receiver of the Brooklyn Elevated Railroad, says, in reference to the prospective relations of the road with the Brooklyn Rapid Transit Company: "People interested in the elevated road are to buy a large block of stock of the Rapid Transit Company, and people identified with the latter company will buy a large block of elevated stock. This will unify the interests in the two roads, and it will be followed by a traffic agreement, so that they may be operated in complete harmony. Trolley cars will be run over the elevated structure, and this will enable us to change to electricity much sooner than we would have been able to do otherwise. But there will be no consolidation, and the two roads will remain independent organizations as heretofore. The elevated roads will take care of the suburban or long-distance passengers, and the trolleys will take care of the short-distance riders."

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Mr. Uhlmann also said that as soon as the reorganization of the Kings County Elevated road is effected it will be consolidated with the Brooklyn Elevated system.

A New Source of Platinum.—It seems that a black sand has been found in the Yukon which is rich in platinum. According to a consular report an analysis showed that at $8 per ounce of platinum this sand contains platinum to the amount of $768 per ton, besides $102 worth of gold.

Difficulties in the Theory of Converters.—In discussing the intricate theory of rotary converters for transforming direct into alternating currents in the same armature or the reverse, a French writer remarks that the converter is the "rendezvous of all the electrical impurities of the whole circuit."

Iron in Alternating Fields.—From some very carefully made experiments by Mr. Wien, in which he determined the hysteresis loops for alternating and continuous currents, he found that with respect to hysteresis the iron behaves as though it were harder when alternating fields are used than with constant fields.

The Boston Elevated Railway.—The first steps in the construction of the Boston Elevated Railway have been taken. A few days ago workmen began digging to make room for the foundations for the iron columns at Lovering place. The work is being carried on in the direction of Roxbury. The holes for the foundations are 50 feet apart.

Does an Auto Tire Hurt?—"Don't look as if it would hurt a feller much to get run over by one of those things," said a countryman in New York, looking at the big pneumatic tires on an electric cab as it pulled up at the front of Madison Square Garden. "Them tires seem to squash down pretty well," he said, and then went across the sidewalk and felt of one of them. "Gosh," he exclaimed, "they're hard as rocks. Guess I'd jest as lief be run over by a skid wagon."

"The Horseless Age," which is the pioneer journal in automobiles in this country, is now to become a weekly, beginning with April 5. The subscription price will be $2 and single copies 10 cents. Several special articles will appear in the April issues. The paper's headquarters are at the American Tract Society Building, New York City. Mr. Ingersoll is to be congratulated on the bright outlook for his self-propelled paper.

Mr. W. H. Preece.—The numerous friends of Mr. Preece in this country will be interested to learn that, according to reports from London, he has entered into partnership with his son, an electrical engineer, and with Major Cardew, of Cardew voltmeter fame, the firm to practice as consulting engineers. It will be remembered that Mr. Preece, who was the electrician for the British government telegraphs for many years, recently retired from that position, having reached the age limit of sixty-five years.

Another California Electric Power Plant.—The Lytle Creek Power Company, of San Bernardino, Cal., will soon commence the construction of a large water-power plant near San Bernardino, the power to be obtained from Lytle Creek. By leading the water but a short distance from where the creek will be tapped a fall of 1600 feet will be available, equivalent to 1500 horse-power. It is also proposed to develop a neighboring source of water power. The company will not depend upon the towns in the vicinity for its sale of power, but will extend its lines to Los Angeles.

Deciding a Court Case Without Experts.—An English showman recently engaged an electrical engineer to construct a platform on which his bear was to be induced to dance by electrical means, whether he was in the humor to do so or not. The showman refused to pay for it on the ground that the persuasive effect of the electric current was not sufficient, and took the case to court. In order to decide it, the defendant and the plaintiff were both made to get onto the platform, from which they were soon very glad to retire, the result being that the bill was promptly paid.

Competition of Automobiles for Heavy Traffic.—The second trial of motor vehicles for heavy traffic will be held at Liverpool, England, for three days, beginning July 2 and ending August 2 next. Runs will be made over distances of 30 to 40 miles from Liverpool, and the vehicles must be propelled by mechanical power alone. Four classes of vehicles will be eligible to enter the contest, the minimum loads being 2, 3½, 5 and 6 tons (long tons). No restrictions will be placed upon the source of the power or the nature of the agents used. Printed copies of the details of the competitioin, regulations, etc., may be obtained from Mr. E. Shrapnell Smith, Honorary Secretary of the Self-Propelled Traffic Association, Royal Institution, Liverpool, England.

Man Power vs. Electric Power.—Recently a new large organ was installed in the famous cathedral of Lincoln, England, which was designed to be operated by electric motors. On the day fixed for the first use of the organ the work on the new central station was not far enough advanced to supply current, and to operate the organ twelve soldiers, under the command of a sergeant, were drafted into service. The organ is now driven by three motors, of 3, 1½ and ¾ horse-power, respectively, there being three wind pressures. By means of an automatic device fixed on the bellows the motors run faster or slower according to the volume of wind consumed.

Wireless Telegraphy in England.—A special dispatch from London of March 18, says: Wireless telegraphy has been put to a really practical test, which has proved how valuable it will be in the future saving of life at sea. Last Saturday a barkentine got ashore on the treacherous Goodwin Sands, and signals of distress were fired from the South Goodwin Light, which were heard on the East Goodwin Lightship, where a wireless telegraph apparatus is fixed, and by that means a message was sent to the South Foreland Lighthouse, where other messages were passed on to Kingsdown and Ramsgate for lifeboats. It often happens that when the wind is blowing off shore guns on lightships cannot be heard on land, and it is in such cases that wireless telegraphy will be of inestimable value in saving life. The Ramsgate town council is now pressing the Trinity House for installations of wireless telegraphy between all lightships and the shore.

How Spain Lost.—According to La Patrie, of Paris, it was the unscrupulous use of the telegraph that made the United States victorious over Spain in the late war. It avers that from January to August, 1898, Colonel Hay, the American Ambassador in London, spent more than $15,000,000 on the British press. The British newspapers, it must be admitted, rarely take money; but, as they have endless columns to fill, they have recourse to the telegraphic agencies, and that explains how during the Cuban war the English newspapers received daily service of 5000 and 6000 words by means of a special apparatus installed in the editorial office, and which turned from morning to night like a windmill. All this matter was supplied to the British newspapers at the cost of their ordinary subscription to the telegraphic agency, and it was materially impossible for the agencies to recoup themselves without immense subventions from the Washington Government. That explains the steady and systematic hostility toward Spain of all the false news which has enabled the Americans to deceive the world. Without the employment of such means the United States would never have succeeded in crushing Spain in the face of a Europe instinctively hostile to their expansion.

Exports of Electrical Material.—The following exports of electrical material were made from the port of New York for the week ending March 14: Antwerp—3 cases electrical material, $30. Alexandria—45 cases electrical machinery, $7620. Berlin—4 cases electrical machinery, $1300; 7 cases electrical material, $60. Brussels—2 cases electrical material, $3. British West Indies—53 packages electrical material, $1108. Brazil—11 packages electrical material, $1051. British Guiana—7 cases electrical material, $309; 1 case electrical machinery, $80. British possessions in Africa—7 packages electrical material, $691. Cuba—38 packages electrical material, $1125. Chili—161 packages electrical material, $6126. Central America—60 packages electrical material, $345. Dublin—41 packages electrical material, $718. Elizabethgrad—11 cases electrical machinery, $1479. Glasgow—11 cases electrical material, $1899. Genoa—3 cases electrical material, $85. Havre—12 cases electrical machinery, $1070; 4 cases electrical material, $143. London—220 packages electrical material, $8622; 6 packages electrical machinery, $195. Mexico—65 cases electrical material, $660. Milan—2 packages electrical material, $73. Moscow—3 cases electrical material, $143. Odessa—30 packages electrical material, $750. Peru—12 packages electrical material, $329. Rome—5 packages electrical material, $302. Santo Domingo—5 cases electrical material, $28. Venezuela—1 case electrical machinery, $13; 27 cases electrical material, $623.

LETTERS TO THE EDITOR.

Efficiency of 220-Volt Lamps.

To the Editor of Electrical World and Electrical Engineer:

Sir—I have read with interest the communication in your March 11 issue from Mr. Merrill H. Fisher, of Lake City, Ia., in reference to high economy, 220-volt lamps.

From a manufacturing standpoint the great obstacle to furnishing a 220-volt lamp of higher economy than 4 watts per candle lies in the conditions existing in and affecting plants using such lamps, and of which Lake City is a fair example. The use of a high-economy lamp requires a correct and close rating in candle power and voltage for satisfactory service and life. The manufacturer cannot supply such a lamp when nearly all the installations are centered on one voltage, as is at present the case with 220-volt lamps, since it is impossible to make all lamps exactly to any given voltage.

The successful adoption of the 3.1-watt 100-volt lamp introduced by the Edison Company in 1888 was rendered possible by the co-operation of central station managers in distributing their voltages (from 100 to 125 volts) to suit the product of the manufacturer. This allowed all lamps manufactured to be sold, and at the same time secured for each station a closely rated product in voltage and candle power. In like fashion it will be necessary for 220-volt stations to distribute their voltages, some taking 205 volts, others 210 volts, 215 volts, 230 volts, 235 volts, etc., and each to then keep its voltage regulation close and constant. Again, the use of a high economy lamp results in early breakage, shorter average life and more rapid decline in candle power, and all to a greater degree with 200-volt lamps than with any other. This makes it a necessity when high-economy lamps are used for the station to absolutely control its renewals—that is, furnish lamp renewals free and periodically replace all dim lamps with new ones.

Where central station customers purchase their own lamp renewals, it is practically impossible to induce them to ever renew until lamps burn out. The customer's idea of lamp value is based solely on the length of life, and their belief is that as long as the central station is properly operated the lamp's candle power is constant. The more rapid loss of candle power of high-economy lamps, coupled with their increased percentage of breakage, would in a great measure offset the saving in power consumed for the individual consumer. This applies where the customer is on a meter basis. When he is on the contract basis he has nothing to gain and much to lose from the use of high-economy lamps, and dissatisfaction would more certainly ensue. This dissatisfaction of central station customers would cause numerous complaints and claims for allowances from the central station or whoever handled the lamps.

It is evident, therefore, that the introduction of a 200-250-volt lamp of higher economy than 4 watts per candle rests to a large extent with the central stations using such lamps.

Let a number of plants operating at a voltage above 200 co-operate with the manufacturer by adopting voltages so that the greatest number of lamps would be required at, say, 220 volts, a slightly less number at 215 and 225, a still smaller number at 210 and 230, and a minimum at 200, 205, 235 and 240. Let these stations either furnish free renewals to customers or, as a means to the same end, control renewals on their circuits by selling lamps at a merely nominal figure (10 cents per lamp), and then keep down their average life within 600 hours by pulling in their dim lamps. The competent manufacturer who is now furnishing a satisfactory 220-volt lamp of 4 watts per candle would then be enabled to furnish a satisfactory 16-cp 3.5-watt lamp of the voltages above mentioned.

A. D. Page.

Harrison, N. J.

Proportions of Armature Cores.

To the Editor of Electrical World and Electrical Engineer:

Sir—In your issue dated March 11, in commenting editorially on "Proportions of Armature Cores," you advance the following conditions (broadly speaking), as those on which the e. m. f. of a dynamo is dependent, viz., "Rate of rotation, the number of poles, the number of turns, and the useful magnetic flux passing through the armature from each pole."

This statement is scarcely correct, in so far as it constitutes the number of poles, rather than the number of pairs of poles, a factor. True, the number of poles limits and controls the number of pairs of poles, but in the latter portion of the quoted expression you consider the effective flux as induced "from each pole," rather than from each pair of poles, which, if accepted, would prescribe an output for a given machine double that for which it is designed.

Toronto, Canada. R. C. Harris.

(Since the number of pairs of poles is always exactly half the number of poles, it is absolutely indifferent whether the e. m. f. be expressed as a function of either.—Eds. E. W. and E. E.)

DIGEST
OF
Current Electrical Literature.

By CARL HERING.

Dynamos, Motors and Transformers.

ROTARY CONVERTERS.

In a short article of a general nature in "L'Elec.," Feb. 25, Mr. Aliamet discusses some of the properties of such machines for transforming direct into alternating currents of various phases in the same armature. The voltages for currents of a different number of phases are calculated, and he shows that the ratio of transformation is not constant for different wave forms, even if the effective voltage at the brushes does not change; this is a serious drawback to the machines. He concludes that a general theory of such converters is practically impossible, as it involves the introduction of all the relative peculiarities of the current, of the power factor, the form of the curve, the voltage, etc., all of which are dependent on things external to the machine and are constantly varying. He adds that the armature of a converter is the "rendezvous of all the electric impurities of the whole circuit." For an equal amount of heating the armature can transform more power when used as a converter of currents than when used simply as a generator of continuous currents. The power being 1 in the latter case, it will be 0.85 for the simple alternating, 1.34 for three-phase currents, 1.64 for four-phase currents, and 1.96 for six-phase currents.—Aliamet. "L'Elec.," Feb. 25.

REFERENCES.

Alternating-Current Transformer.—The beginning of a long article of a general nature, discussing the conception and representation of what takes place in the alternating-current transformer. In the present portion, after a rather long introduction, the transformer diagram and the relation of the voltage and current are discussed. The treatment is chiefly graphical.—Heinke. "Elek. Zeit.," March 2.

Choking Coils.—Brief discussions of the action and calculation of choking coils.—Lond. "Elec. Eng.," March 3.

Lights and Lighting.

THE NERNST LAMP.

It appears that the publication of a portion of the report of the company in Berlin which is the owner of the Nernst patents, and which was noticed in the "Digest," March 11, has led to a letter from Mr. Swinburne in a daily paper in London, calling in question the accuracy of the Lond. "Elec. Rev." extracts from that German report. The latter journal, therefore, in its issue of March 3, gives the original German of that extract, the whole of which is in the "Elek. Zeit.," Dec. 15, p. 848. The view which the English journal takes is that the capital of the company which is at present being formed in England seems much too large for something which is really only in its experimental state. It suggests that if the promoters are as sanguine of success as they claim to be, they might show it by holding all the shares for five years, and if at the end of that period they can dispose of them at par that journal will ac-

knowledge its surprise. (Much of this unfavorable criticism at present in the English journals has reference to the company which is being formed, as distinguished from the lamp itself. That the lamp appears to be very promising does not seem to be doubted, but it is thought that for the present state of the lamp the company seems to be overcapitalized.)—Lond. "Elec. Rev.," March 3.

A brief note from Mr. Fanta, published in the Lond. "Elec. Rev.," March 3, states that he has given the Nernst lamp his attention for some time, and has made experiments which have so far been quite satisfactory, and which enable him to state confidently that by a certain process, which he does not describe, lamps of any candle power and voltage can be produced, consuming only 1.5 watts per candle. He concludes with a brief but very important statement that no preliminary heating is required. Unfortunately he says nothing more than this.—Lond. "Elec. Rev.," March 3.

The question of priority of invention is discussed in Lond. "Engineering," March 3, the illustrations from the Jablochkoff and from the Nernst patent being reproduced, and portions from the specifications of the latter are quoted. Besides the early references, it is stated that Du Moncel also called attention to a distinct contrast between low and high resisting bodies; he said that when heated and cooled their actions are diametrically opposite, the latter becoming better conductors when heated, while the former increase in resistance. It is also stated that the lamp in the Jablochkoff patent was shown in an exhibition in London in 1879, although generally in the unlighted state; it was, however, lit on one evening, or at least on a part of an evening. Concerning the later Nernst patents, in which claims are made for the admixture of certain refractory oxides, it is stated, in reference to the light-giving properties of various oxides, that "common sense inclines one to believe that any non-wasting refractory body would glow as brightly as any other non-wasting body at the same high temperature." It is also thought that Nernst's invention should still be looked upon as being in the experimental stage. Also that the chances of the new departure need not at present alarm any vested interests in the trade. It is thought that the first and keenest competition of the new lamp will be with the outdoor arc lamp.—Lond. "Engineering," March 3.

DIFFUSED ILLUMINATION.

A brief, illustrated description of the Lembert system is given in the "Zeit. f. Beleucht.," Feb. 28. It is of use specially in textile factories, where diffused illumination and absence of shadows are important. Wherein the novelty lies is not made clear. The lamps are on the top of posts reaching apparently about half way to the ceiling. Below them is an enameled reflector, completely shutting off the direct rays and reflecting them toward the ceiling, while above the lamp is a ground-glass shade. The light is reflected back from the ceiling. In a certain cotton factory with a shed-like roof, the length of the room being 78 metres and the width 35, it required thirty-two lamps of 12 amperes to give an illumination of 12 luxes. In another room, with a vaulted ceiling, 78 metres long and 11 wide, ten lamps produced about the same illumination.—"Zeit. f. Beleucht.," Feb. 28.

REFERENCES.

Arc Lamp.—A brief, illustrated description of a lamp whose arc is fixed in position, made by Siemens & Halske.—"Zeit. fuer Elek.," Feb. 26.

Power.

LARGE PROPOSED TRANSMISSION PLANT.

A brief report concerning a project of what is said to be the largest electrical transmission plant under construction or consideration in Europe, is published in "L'Energie Elec.," Feb. 16. The report is very brief, but concludes that the project seems feasible. The water power of the river Loue is to be used; the height of the fall is about 500 feet; it is proposed to transmit 3,000 horse-power to the city of Dijon, in France, a distance of 72 miles. For this power, at fifteen hours per day at Dijon, the price is estimated to be $28 per year, or 0.63 cents per hp hour; the cost of the whole installation is estimated to be $1,100,000. It is said that a company has been formed to carry it out. The report says that no insurmountable technical or financial difficulties are incurred, and that there would be a good market for all this power in that city. This is practically all the information which that notice contains.—"L'Energie Elec.," Feb. 16.

ROME-TIVOLI INSTALLATION.

A very long, profusely illustrated description of this interesting installation is given by Mr. Dubsky in "Cassiers' Mag." for March. There is a steam plant of 27,000 horse-power in the city itself, and a newer plant at Tivoli, 17 miles distant, where a large water power is used to generate alternating currents of 5500 volts, and both of these provide current in Rome for lighting and power, including the electrical railways. The arcs are run in series of 50 each, and the railways are supplied from rotary converters (motor-dynamos), transforming down to 550 volts continuous current without the use of static transformers. Moreover, these converters operate in parallel with a storage battery.—Dubsky. "Cassiers' Mag.," March.

LARGE MINING PLANT IN WESTERN AUSTRALIA.

A note in the Lond. "Elec. Rev.," March 3, states that a company is being formed to construct a central power station for the Kalgoorlie gold fields, with a capital of two and a half millions. It will be a 5000-hp plant, and it is thought that it will reduce the cost of working the mine about 25 per cent. It is said that it will be the largest plant of its kind in the world.—Lond. "Elec. Rev.," March 3.

REFERENCES.

Elevators for the Central London Railway.—The beginning of a well-illustrated description, including good working drawings, of the passenger elevators for this underground electric railway. These elevators, which are of the Sprague type, were designed and made in this country. The worm and nut system is used, with an endless path of ball bearings. The type of elevator has already been described. The illustrations refer chiefly to the mechanical features.—Lond. "Engineering," March 3.

Alternating-Current Transmission.—The continuation at very great length of the long paper noticed in the "Digest" Feb. 4. The present portions are on special properties of induction motors, the excitation of non-synchronous motors, and on re-dressers of alternating currents.—Leblanc. "Bul. Soc. Int. des Elec.," Feb.

Traction.

DIRECT VS. THREE-PHASE CURRENT FOR RAILWAYS.

Mr. Huber, of the large Oerlikon Company, in Switzerland, read a paper recently in which he compared the relative advantages and disadvantages of these two forms of currents for railways, a long abstract of which is published in the "Elek. Zeit.," March 2. While in general the relative advantages are already understood, the opinions coming from this large company are of interest. When the use of high voltages is a necessary condition the three-phase system will always have the advantages in the calculated cost of installation. The voltage on the cars is limited, in most cases to below 1000 volts, and in the majority of the present installations to not more than 600 volts. A table is reproduced giving the itemized cost for a line about 12 miles long for 600 volts, for the continuous, three-phase and converted continuous current, with the power station in the middle or end of the line. This table shows that the results are more favorable to the three-phase current the greater the distance and the power. For plants like those in a city, or for a distributed plant in a limited area, the three-phase current can in general show no advantages, even in the calculated cost of the plant. For very great distances recourse must be had to three-phase currents transformed to continuous. He calls attention to the great complications in the overhead wires for the three-phase current when the lines cross as in a city, and lays considerable stress on this. In general he comes to the conclusion that the three-phase current, as far as the lines and moving contacts are concerned, is at a distinct disadvantage, while on the other hand, under certain circumstances, there is a very great saving in amortization and cost of plant. A comparison of the desired qualities of the motors is then made. He admits that the two kinds are about equal in their starting torque, and in the best efficiency during the most usual, largest load, and in their ability to deal with unusually high temporary loads, yet the three-phase motor fails in the best utilization of the energy to obtain the best speed and to increase the speed above the normal; it is better than the continuous-current motor in that all grades are mounted at the same speed, a condition, however, which is not a necessary one. In general the continuous-current motor endeavors to develop a constant power, while the three-phase motor tends to keep the speed constant. A number of the characteristic curves of the two motors, showing their properties, are reproduced, as taken from actual cases. He concludes that the three-phase motor is not as well adapted for traction work as the continuous, and that the very properties which make the former preferable for stationary work are the very ones which are against it for traction work. The three-phase motor is adapted to railroads of considerable length and about equal grades, but for all other cases in general the three-phase motor has advantages only in the calculated cost of the installation and amortization.—Huber. "Elek. Zeit.," March 2.

ELECTRIC AUTOMOBILES.

In the continuation of the lecture of Mr. Egger (noticed in the "Digest," March 4), in the "Zeit. fuer Elek.," Feb. 12, he shows how the requirements discussed in the first part are fulfilled in electric automobiles referring chiefly to the vehicles exhibited last year in Paris. In the conclusion in the issue of Feb. 19 he discusses the various methods of regulation of the speeds, but apparently gives nothing new. He mentions a formula suggested by Chauveaux for comparing different vehicles in a competitive test, on the ground that it does not necessarily follow that the most rapid one is the best. He obtains a factor by dividing the power of the motors by the product of the number of passengers, and the average distance covered in an hour; the smaller this factor, the better the vehicle, as it represents the power required per passenger per kilometre. Applying this formula to a recent test changes the order of merit very greatly, the vehicle which received the first prize being fifth, while an obscure one was the best. Estimates are given for the relative costs of operation of electric and horse vehicles, showing that they are nearly equal. In conclusion he refers briefly to the Lohner electric vehicle, which, apparently, is made in Austria.—Egger. "Zeit. fuer Elek.," Feb. 12 and 19.

STEEP GRADE ELECTRIC RAILWAYS.

The "Eng. & Min. Jour.," March 11, calls attention to the successful operation of the electric railroads in Butte and in the Cripple Creek district, over very high grades, and states that these have set an example which may well be followed in other mining towns. The addition of a freight service will follow as a matter of course. There are many other mining districts where local transportation is a serious difficulty and a heavy charge, and it is thought editorially that in a number of these the electric system will be the best possible solution. It suggests that capitalists would do well to inquire whether there is not an opportunity for profit in building electric lines in Western mining camps, as well as in Eastern cities.—"Eng. & Min. Jour.," March 11.

CARS FOR THE BUDAPEST RAILWAY.

The "Zeit. fuer Elek.," Feb. 19, has a brief reference to the ninety new motor cars of what is known as the Dresden type, for the Budapest Railway. They have two axles, carry forty-eight passengers, weigh, complete, but without passengers, 9050 kg, require 32.4 amperes at 400 volts for the empty car on the level, or 439 watt hours per car kilometre, or 46.7 per ton km.—"Zeit. fuer Elek.," Feb. 19.

REFERENCES.

Return Railway Feeders.—The beginning of a long translation in abstract of Boehm-Raffay's article in the "Elektrotech. Neuigkeits Anzeiger," 9, 10 and 11, which is said to be of considerable interest. The object of the article is to give simple formulas or graphical methods for determining the cross-section of return feeders. The article is mathematical in character, and is not of such a nature that it can be abstracted. The mathematics involved appear to be comparatively simple.—Boehm-Raffay. Lond. "Elec. Rev.," March 3.

Accumulator Traction at Ostende.—The complete brief paper, an abstract of which was noticed in the "Digest," March 11.—Sarcia. "Bul. Soc. Int. des Elec.," Feb.

Installations, Systems and Appliances.

CITY OF LONDON PLANT.

An illustrated description of the central station in what is called the City of London, which is a portion of the whole metropolis, is begun in the Lond. "Elec. Rev." and "Elec. Eng.," March 3. At present there is available 11,660 kilowatts. The cost of the plant, including land, buildings, street mains, etc., is at the rate of $585 per kilowatt. There are engines and dynamos of all sizes, amounting in all to thirty sets, the largest of which has an output of 1500 kilowatts. There are a number of alternators, some of American manufacture. For power purposes there is an alternator and a direct-current dynamo, which are coupled by belting, the alternator being run as a synchronous motor brought up to synchronism by the direct-current dynamo.—Lond. "Elec. Rev." and "Elec. Eng.," March 3.

REFERENCES.

Wycombe.—An illustrated description, much longer in the first of the two journals, of this small direct-current station. At present there are two high-speed engines of 120 horse-power directly coupled with dynamos giving 420 to 460 volts. A battery of 230 cells is charged by means of a small booster.—Lond. "Elec. Eng." and "Elec.," March 3.

Accumulator-Regulating Switch.—A well-illustrated description of a modern construction of a switch for cutting in and out the end cells of a series of accumulators which are in parallel with generators. Working drawings of the switch are given.—Mueller. "Elek. Zeit.," Feb. 23.

Lincoln.—An illustrated description of this municipal plant, in which the continuous-current, low-pressure, three-wire system is used with accumulators. At present there are three direct-coupled generating sets, each of 50 kilowatts.—Lond. "Elec.," March 3.

Cologne.—A table of operating statistics, including costs, of this large station, the total useful output of which for the year ending April, 1898, was 1,187,000 kw hours.—"Elek. Anz.," March 2.

Switches and Interruptors.—The continuation of the long discussion before the International Society, which was noticed in the "Digest" Feb. 11.—"Bul. Soc. Int. des Elec.," Feb.

Wires, Wiring and Conduits.

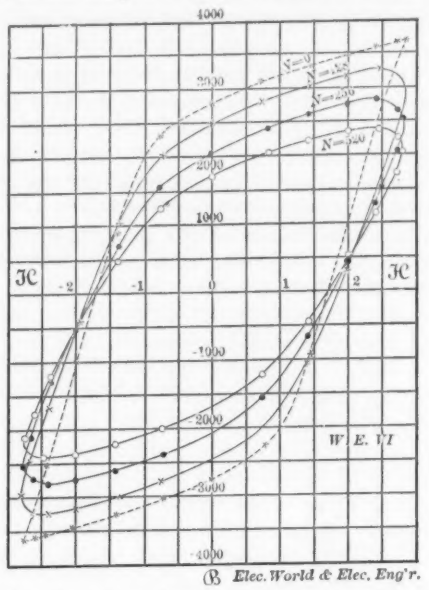
COPPER.

The present high price of copper is discussed editorially in the "Eng. & Min. Jour.," March 11. There seems to be considerable discussion as to whether that price can be maintained. The talk about speculative combinations is considered as nonsense. Speculators cannot long maintain the rise unless the trade favors them; the conditions which enter are discussed. It is considered quite certain that a collapse will come, and that it is only a question of time, and probably of a short time. Meanwhile the present condition of the market is injurious to the trade, and the sooner it passes over the better.—"Eng. & Min. Jour.," March 11.

Electro-Physics and Magnetism.

MAGNETIZATION BY ALTERNATING CURRENTS.

What seems to have been a very long series of carefully made experiments by Mr. Wien is described in the "Wied. Ann.," 66, p. 859, a long abstract of which is given in the "Elek. Zeit.," March 2. He measured the magnetic induction and the loss of energy in



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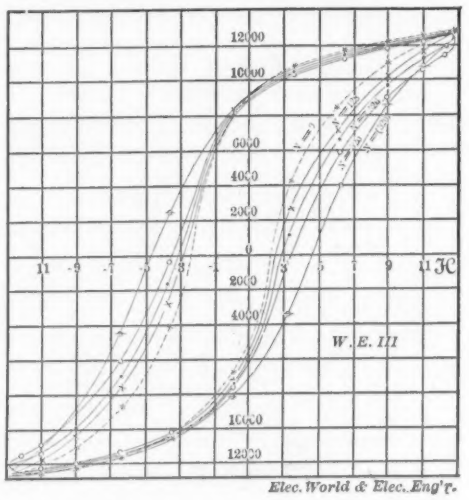
the magnetization by alternating currents, of frequencies of 128, 256, and 520 per second, and compared them with the correspond-



Elec. World & Elec. Eng'r.

ing quantities determined by calculation based on the hysteresis loops determined statically; he was very careful to take into consideration all the sources of error. The iron was composed of very small rings from 1.6 to 35.8 cm in circumference, made of very

thin iron wires; each was wound with two windings, the inner one for magnetization by alternating currents and the other for determining the hysteresis loops with a constant current. The results show that a sinusoidal magnetizing force develops not only an induction corresponding to its period, but also inductions of higher periods, which are stronger the nearer saturation is approached. They induce currents of higher periods in the iron, as also in the magnetizing coil. The loss of energy by magnetization with a sinusoidal current therefore consists not only of a hysteresis loss and that due to Foucault currents of the period of that current, but there is also a loss of energy due to Foucault currents of higher periods, and the heat loss due to currents of higher periods induced in the magnetizing coil. A special insulation of the iron wires is useless, as the action of the Foucault currents is the same for insulated or bare wires, in accordance with Oberbeck's theory. The experiments with sine currents of different frequencies showed that the permeability and induction are always smaller in the sine field than in the constant field; the differences are greatest near the maximum permeability, and become less the nearer they approach to saturation; for very weak fields the values were nearly the same for all frequencies. All the differences are greater the higher the frequency, and the softer and thicker the iron wire. The loss of energy by hysteresis, not including that for very weak fields, is always greater for the same induction from alternating currents as that determined from the hysteresis loop measured statically. This increase becomes greater with the frequency, and is greatest near the point of saturation. The energy loss due to hysteresis for equal magnetizing forces in weak fields is less with alternating currents than with constant magnetization, as the induction is appreciably less. The observations seem to show that the induction cannot follow very rapid changes in the magnetizing force. The hysteresis loops for rapid magnetizing cycles have a different shape than those determined, with slowly changing forces; they become broader and shorter, or, in other words, the iron behaves as though it were harder, in rapidly alternating fields than in a constant field. The curves for two of the rings are shown in the adjoining figures. Their peripheries were 3.12 and 1.64 cm, the latter figure referring to the sharper and narrower loops. Their volumes were 0.0128 and 0.00264 cb cm. Those marked $N = O$ refer to a constant current, while the three others, marked 128, 256 and 520, refer to these frequencies.—Wien. "Wied. Ann.," 66, p. 859; abstracted in the "Elek. Zeit.," March 2.

MAGNETIZATION OF HOLLOW AND SOLID CORES.

Several recent articles bearing on this subject are abstracted in "L'Eclairage Elec.," Feb. 11. It has been noticed by different investigators that there is a difference in the magnetization of a cylinder, depending upon whether it is solid or hollow, and the various experiments made were intended to investigate this. Du Bois thought the cause of this difference in magnetization was the demagnetizing action exerted by the free magnetism of the cylinder, and that experiments should be made with hollow cores, in which the demagnetizing action is avoided. Experiments in this direction were made by Kirstaedter and described in the "Wied. Ann.," 65, p. 71. He first examined a solid cylinder and after cutting it in half lengthwise the inside was cut out so as to leave a hollow cylinder. The results all lead to the conclusion that the theory of Kirchhoff of the magnetization of solids of revolution applies to this case also.—The penetration of magnetization into iron was investigated in a paper by Stefanini, in the "Nuovo Cimento," March, 1898, and in one by Ascoli in the July number. Their results show that the distribution of magnetization is uniform, and that no trace of a protective action of one layer on the other exists.—In an article by Arons, in the "Wied. Ann.," 65, p. 590, he shows how to calculate the magnetic screening effect.—"L'Eclairage Elec.," Feb. 11.

INDUCTION BY STEADY CURRENTS.

An interesting combination of an experiment by Ampere with one of Faraday's is described in the "Phil. Mag.," March, by Mr. Chabot. Two independent circuits or loops are placed in the same horizontal plane, say, on a table; a magnet capable of revolving around its axis is placed horizontally over them, so that one pole of the magnet is over the centre of one loop and the other pole over the centre of the other. A steady current in the first circuit will cause the magnet to rotate about its axis, as was shown by Ampere; the rotation of the magnet about its axis will give rise to a steady current in the second loop, according to Faraday; if the magnet is capable of revolving, it follows that a steady current in the first circuit induces a steady current in the second, the magnet forming the connecting link. In a lecture experiment a brake should be applied to the magnet, the induced current taking place only when the brake is removed.—Chabot. "Phil. Mag.," March.

CATHODE, LENARD AND ROENTGEN RAYS.

Some years ago J. J. Thomson proposed the hypothesis that the matter in the cathode stream consists of atoms resolved into particles of that primitive substance out of which atoms have been supposed to be composed. In a paper by Mr. Sutherland, in the "Phil. Mag." for March, he examines whether the facts to be explained by such an important theory are not better accounted for by the logical developments of widely established and largely accepted principles of science. He believes a complete theory of electricity will be a kinetic one, in which the place of the atoms or molecules of the kinetic theory of matter is taken by the electrons. The ion appears as a sort of molecule formed by the union of atom or radical to an electron. The contentions in his paper are that the cathode and Lenard rays are streams, not of ions, but of free, negative electrons; and that Roentgen rays are caused by the internal vibrations of free electrons.—Sutherland. "Phil. Mag.," March.

THE PRODUCTION OF AN ELECTRIC SPARK.

Mr. Walter, in the "Wied. Ann.," 66, p. 636, describes some experiments in which he photographed the spark of a Ruhmkorff coil on a moving plate; a brief abstract of the article is published in "L'Eclairage Elec.," Feb. 2. He found that a broad spark is followed at equal intervals of time by less brilliant ones, and that the direction of the current was the same for all these consecutive sparks, which was noticed by the fact that between platinum electrodes the negative pole produces a more intense light than the positive. The consecutive sparks follow at intervals of time equal to the period of the oscillation of the system. When the interrupter is first started, no spark was produced at the secondary, but there was a brush discharge which became longer at every successive interruption of the current, until, finally, it united the two poles and then became a spark.—Walter. "Wied. Ann.," 66, p. 636.

CONDUCTIVITY OF THIN LAYERS OF DIELECTRICS.

It was noticed some years ago that the resistance of very thin sheets of gutta percha, paraffin or sulphur changes with the current passing through them. Mr. Leick, in the "Wied. Ann.," 66, 1107, abstracted briefly in "Elek. Zeit.," March 2, finds that these three dielectrics have a better conductivity in thin than in thick layers; it is dependent also on the current strength, the resistance diminishing greatly with increasing currents. There is also an action resembling that of hysteresis, as the resistances obtained by gradual diminution of the current are always smaller than those determined first with the same current. While gutta percha and paraffin show no polarization, sulphur shows a very strong one. —Leick. "Wied. Ann.," 66, p. 1107; noticed briefly in "Elek. Zeit.," March 2.

THEORY OF VOLTAIC ACTION.

Mr. Brown recently described some experiments before the Royal Society bearing on the theory of contact electricity, an abstract of which is published in the Lond. "Elec.," March 3. It is thought that the electric potential on the surface of two metals in contact is caused or influenced mainly by the chemical activity of films condensed on their surface from the surrounding gas. If this is the case the difference of potential would disappear if all chemically active films or gases capable of producing them were removed. The experiments described were undertaken to test this, but one of them supports this hypothesis, and they, therefore, cannot be considered to confirm it, although he still thinks that there is overwhelming weight of evidence to support the hypothesis.—Brown. Lond. "Elec.," March 3.

NEW WAVE INDICATOR.

A very simple form of wave detector was described by Mr. Neugschwender, in the "Wied. Ann.," a brief abstract of which is given in the Lond. "Elec.," March 3. He scratches a gap about 0.3 mm wide through the coating of silver on a glass mirror, and then inserts this gap in the circuit of a Daniell cell and a galvanometer. On breathing upon the mirror the condensed vapors bridge the gap and the galvanometer shows a deflection, which is immediately annulled when an electric wave impinges on the mirror. A piece of moistened cloth near the mirror renders the action continuous. Every train of waves produces an infinite increase of resistance while it lasts, and on its cessation the normal current is re-established. The response is so rapid that the individual discharges of an induction coil are indicated separately, as shown by a telephone in the circuit.—Neugschwender. "Wied. Ann.," No. 2.

MAGNETIC VISCOSITY.

What seemed to be quite extended researches have been made by Fromme, the results of which are briefly abstracted in "L'Eclairage Elec.," Feb. 11. All the results obtained are easily explained by the Ewing theory. The circumstances which cause an acceleration of the movement of the elementary magnets diminish the viscosity; the effect can be in the reverse sense when this acceleration is sufficient for the elementary magnets to momentarily pass beyond the position of equilibrium.—Fromme. "Wied. Ann.," April, 1898.

EFFECT OF MAGNETISM ON THE HEAT CONDUCTIVITY.

In a recent French Physical Society paper Mr. Korda read a paper on the effect of magnetism on the calorific conductivity of iron, in which he described experiments which led him to the conclusion that the calorific conductivity of soft iron is diminished in the direction of the magnetic lines of force, but it remains the same in the direction of the equipotential lines, independently of the direction of the magnetizing force.—Korda. "L'Eclairage Elec.," Feb. 25.

REFERENCES.

Conduction Through Gases.—A long discussion of the theory of conduction of electricity through gases by charged ions. The electrical conductivity possessed by gases under certain circumstances, as when subjected to Roentgen rays or in vacuum tubes, etc., may be regarded as due to the presence of charged ions in the gas, the motions of which in the electric field constitute the current.—J. J. Thomson. "Phil. Mag.," March.

Unipolar Discharges.—If the two electrodes of a vacuum tube are both connected to the same pole of an influence machine, or a Ruhmkorff coil, the whole tube will be illuminated. Mr. Battelli made a complete study of this phenomenon.—Battelli. "Nuovo Cimento," Feb., 1898; noticed briefly in "L'Eclairage Elec.," Feb. 25.

Static Motors.—A brief, illustrated description of some motors operated by static machines, in one of which there is direct rotation and in the other a reciprocating motion. (It may not be generally known that an influence machine will run as a motor if connected to another influence machine.)—Dailey. "Sc. Am.," Feb. 25.

Calculation of Foucault Currents.—Deductions of formulas for calculating the power absorbed by Foucault currents in conductors. The formulas seem comparatively simple, but do not admit of being reproduced here.—Grassi. "L'Elettricita," Aug. 1, abstracted in "L'Eclairage Elec.," Feb. 25.

Discharges in the Air.—Descriptions of experiments made with discharges in the air at normal pressure and between the poles of a magnet; it was shown that the discharges act like those in vacuum. —Precht. "Wied. Ann.," 66, p. 676; noticed briefly in "L'Eclairage Elec.," Feb. 25.

Electrocapillary Phenomena.—An abstract of a Royal Society paper on the two assumptions in the Lipmann-Helmholtz theory of the capillary electrometer.—Smith. Lond. "Elec.," March 3.

Hertzian Experiments.—A description of a new method of showing Hertzian experiments.—Precht. "Wied. Ann.;" abstracted briefly in "L'Eclairage Elec.," Feb. 25.

Brush Discharge.—A brief description of some experiments similar to those described by Dr. Cook in the "Phil. Mag." for Jan.—Marchant. "Phil. Mag.," March.

Electro-Chemistry and Batteries.

NEW PRIMARY BATTERY.

A new primary battery, which is claimed to be adaptable for automobiles, is briefly described in the "Elec. Tech., Feb. 28. It was invented by a young Frenchman, whose name, however, is not given. It is claimed that the depolarization is complete, and that the battery is therefore better adapted for strong currents than those usually used. The characteristic and apparently novel feature is that in the exciting liquid and in the negative or positive electrode there is either a salt, acid or oxide of vanadin. The outer compartment contains a solution of chloride of sodium in the proportion of 20 to 100 of water, in which there is an amalgamated zinc electrode; in the inner porous cup there is a carbon plate surrounded by retort carbon and granulated manganese oxide (presumably that used in Leclanche cells) and fused vanadin acid; it also contains some sulphuric, vanadic and hydrochloric acids. In the outer compartment can also be added some sulphuric acid. The solution in the porous cup may also be a mixture of chloride of potassium with about 5 per cent. of oxy-chloride of vanadin. The depolarization is said to be very energetic, and the reducing action of the hydrogen is regulated by the vanadin acid. The addition of about 10 per cent. of bichromate of potash increases the action of this cell, and in this way a cell (whose dimensions are not given) will yield 13 amperes at 2 volts during a much longer time than the usual bichromate or Bunsen cells. When it is desired to make them transportable and to adapt them more especially to automobiles, the outer cells are made of hard rubber and contain the carbon electrode, while the zinc is in the form of scraps placed in the porous cup. It is said that experiments in Paris with automobiles have shown this cell to be quite practical.—"Elec. Tech.," Feb. 28.

ELECTROLYTIC IRON.

Electrolytic iron is not pure, as it contains 100 to 150 times its volume of hydrogen, and, according to Lockyer, traces of at least ten other metals, a very important impurity being carbon, which occurs in amounts from 0.08 to 0.03 per cent. It appears that the quantity of carbon which comes over depends on the form in which the carbon occurs in the anode, and to test this Mr. Houllevigue made some tests, which are described in the "Jour. de Phys.," Dec., and noticed briefly in Lond. "Elec.," Feb. 24. He used pure steel, containing 0.4 per cent. of carbon, and found that the results differed according to the treatment of the steel before electrolysis; one piece was tempered, while the other was cooled slowly, the former containing carbon dissolved in iron but not combined with it, while the latter contained carbon combined with iron. The former yielded electrolytic iron with practically no carbon, while in the latter the amount of the carbon deposit was 0.03 per cent. of that of the iron. It seems from this that some compound molecule of iron and carbon exists which is capable of acting as a cation like cyanogen.—Houllevigue. "Jour. de Phys.," Dec.; Lond. "Elec.," Feb. 24.

LOW VOLTAGE ELECTROLYSIS OF WATER.

In a short article by Mr. Tommasi, in the Lond. "Elec. Rev.," Feb. 24, he describes briefly the various methods by which water was alleged to have been decomposed with less than the theoretical e. m. f., 1.47. This shows that there is an apparent contradiction, which he explains by means of the phenomena of dissociation. He believes that water must contain a certain quantity of hydrogen and oxygen which is not combined, but the molecules of which are nevertheless sufficiently close to exercise a certain attraction on one another; it is those gases that are evolved with less than the required voltage. This, however, he does not consider a true decomposition. In decomposing water there are two distinct phases; in the first the dissociated elements are carried to the two electrodes and in the second the products are given off. If the e. m. f. is less than the required amount, there will not be any real electrolysis, but only separation of the elements, a process which he designates by the name of pseudo-electrolysis.—Tommasi. Lond. "Elec. Rev.," Feb. 24.

REFERENCES.

Ozone.—An unfavorable criticism of a recent paper by Engledue, read in London, on the Yarnold ozonizer. It was claimed that 175 grams of ozone were produced per hp-hour, and this the present writer questions, calling attention to the difficulties encountered in an analysis for determining the quantity of ozone.—Andreoli. "L'Elec.," March 4.

Electro-Chemistry.—A long article in the nature of a theoretical treatise including a discussion of various hypotheses.—Minet. "Bulletin Technique," Jan.

Units, Measurements and Instruments.

METHOD OF MEASURING INDUCTANCE.

A method, which seems to be a feasible one for making accurate measurement, is described by Mr. Martienssen in the "Wied. Ann.," No. 1, an abstract of which is given in "Science," March 3. The method is an improvement on the one suggested by Puluj, and independently by Prof. Moreland, as described in a paper at the recent Boston meeting of the American Association. The method in its simplest form is to connect two circuits in parallel in an alternating-current circuit and adjusting non-inductive resistances in the two branches until the currents in both are in phase; the inductances in the two branches are then directly proportional to the resistances. This requires an instrument for showing when the phases are alike. This is essentially a small induction motor without iron, consisting of two small coils at right angles, surrounding a suspended aluminum or copper rod. These coils are connected to the two circuits, and when the phases are not alike a deflection of the suspended rod will be produced. Martienssen modifies the instrument by winding one coil with two strands of wire, each provided with

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separate terminals; one of these strands is connected in the circuit as before, while the other constitutes a secondary coil in which a current is induced approximately in quadrature with the primary, and by the use of an adjustable non-inductive resistance in this secondary circuit the instrument may be used for the accurate measurement of much smaller inductions. (This is the description in the abstract of the article, but unfortunately it is not quite clear.) This modification is a zero method, and requires only a single adjustment, and no harmonic e. m. f. nor a knowledge of the frequency; it gives accurate results for inductances between a few hundreds to many millions of centimetres.—Martienssen. "Wied. Ann.," No. 1; "Science," March 3.

STANDARD CELLS.

Mr. Mauri made some investigations with standard cells differing from those usually in use, and gives the results in the "Atti del R. Istit. Lomb.," Vol. 30. He also proposes a new form of cell, a brief description of which is given in "L'Eclairage Elec.," Feb. 25. It consists of a large retaining cell of glass, in which there is a smaller one, whose height is also less; in the latter there is a disc of zinc connected to a rod of zinc, which latter is protected by a glass tube filled with mercury. The large jar contains pure mercury over which is placed the salt of mercury with crystals of the zinc salt: some crystals (presumably of the zinc salt) are also placed in the smaller jar. A saturated solution of the salt of zinc is then poured into the jar until the level is about 1 cm above the edges of the inside jar. A platinum wire protected by a glass tube makes contact with the mercury. This form has the advantage of not having a great internal resistance. He gives a table of the e. m. fs. of such a cell made with the acetate of mercury and acetate of zinc; at 15° C. it was 1.3266 volts; it varies only a tenth as much as the Clark cell, with the temperature, and reaches its constant value at the end of a day.—Mauri. "L'Eclairage Elec.," Feb. 25.

MEASURING PHASE SHIFTING IN THREE-PHASE MOTORS.

Mr. Friese, in "Elek. Zeit.," Feb. 23, claims that the method recently described by Dr. Breitfeld (see "Digest," March 4) has been in use for quite a long time. In practice these formulas give good and useful results. He adds that if the separate values involved in the formula are measured with an electric meter instead of a wattmeter, then the same formula gives the mean phase shifting during any particular time, and he thinks this the most convenient method to measure this quantity, which is often of interest. Mr. Michalke also states that a similar method has been used for a number of years in order to determine the phase shifting with only two readings of the wattmeter. The connections, which are illustrated, are like the usual ones for determining the power in the three-phase circuits for unequal currents in the three branches. For the first reading the series coil is in one circuit and the shunt coil is connected between that and the third circuit; for the second the series coil is in the second circuit and the shunt coil is connected between the second and third. He gives the formulas and diagram for this arrangement.—"Elek. Zeit.," Feb. 23.

LONG SCALE AMPERE AND VOLT METERS.

A new form of these instruments is briefly described in a recent paper by Mr. Davies before the Physical Society, a very brief abstract of which is given in the Lond. "Elec.," March 3. The instruments are of the moving scale type, are portable and have a very uniform scale throughout, of very long range. The magnetic circuit has only one air gap, which is generally a space between a central cylinder of iron or steel and a concentric tube of iron. The central cylinder is bored axially, and one side of the rectangular coil is pivoted at the top and bottom of the hole, the coil therefore swinging around one side, and the second side moving in the circular path in the angular air gap. In the discussion, Prof. Ayrton said that the instruments appeared to be very successful, which opinion seems to have been based on experience with them.—Davies. Lond. "Elec.," March 3.

REFERENCES.

Measuring the Insulation of Three-wire Circuits.—The insulation resistance of a three-wire circuit, with an insulating neutral, can be measured while in use, as is well known, with a galvanometer or Weston instrument, but when the two voltages and the two deflections for the two sides are equal the method fails. In the present article the author shows by means of an example how in this case it is possible to at least determine the lower limits of the resistances. No general description is given, as he simply works out one example which does not admit of being described in abstract.—Kollert. "Elek. Zeit.," March 2.

Telegraphy, Telephony and Signals.

WIRELESS TELEGRAPHY IN 1849.

A brief description of a method proposed by Mr. Wilkins, in 1849, for telegraphing across the English Channel, is reprinted in Lond. "Elec. Rev.," Feb. 24, from the "Mining Journal," March 28, 1849. He suggests the now well-known method of passing a current through the sea between two points on the one shore, about 20 miles apart, and grounding two ends of a similar length of wire on the opposite shore, parallel with and as near to the wire on the other shore as possible, the ends dipping into the sea. A current passed through one of the wires should then produce a small current in the other, the second being a sort of shunt to the path of the first circuit through the sea. He suggests using a fine wire coil suspended between the poles of an electromagnet, to detect these currents, which will necessarily be small.—Lond. "Elec. Rev.," Feb. 24.

AN ALL-BRITISH CABLE SYSTEM.

The Lond. "Elec." has an editorial criticism of an article by Mr. Hurd in the "Nineteenth Century" for February in which it was proposed to connect the different points on British territory by submarine cables, to be built and owned by the Government at a cost of thirty million dollars. In this way it is proposed to have a double route to almost every one of the important coaling stations. The editorial states that the scheme might well be objected to on many grounds, including those of justice, necessity, efficiency, economy and policy. Such state action would destroy the international character which submarine cables have hitherto borne, and would lead to other governments laying cables of their own, landing on their territory.—Lond. "Elec.," March 3.

MULTIPLE TELEGRAPHY.

The system devised by Cerebotani is briefly referred to but not described in the "Elec. Tech.," Feb. 28, in an abstract of a recent lecture. It is based on a method of synchronism, and makes multiple telegraphy possible in either direction simultaneously. Moreover, it can be used not only for the Morse system, but also for the type printing systems (referring presumably to those like the Hughes, which are in common use in Europe). The important feature seems to be that at both stations the sending and the receiving apparatus are separated, as there are two metallic discs at each end, over which the brushes move, one for sending and the other for receiving. A special synchronizing device is used, but is not described. The apparatus has been constructed, and has been practically applied.—"Elec. Tech.," Feb. 28.

RADIOPHONY.

A method of transmitting sound by means of ultra-violet light is described by Mr. Sella, in the "Nuovo Cimento," Oct., a brief abstract of which is given in the Lond. "Elec.," Feb. 24. A telephone is placed in the circuit of a strong influence machine in series with a short air gap. If a beam of ultra-violet light is directed on to the negative terminal of the gap the sound in the telephone is greatly altered. If the ultra-violet light undergoes periodic variation the sound in the telephone will vary in the same way, and on this principle he constructs his radiophone.—Sella. "Nuovo Cimento," Oct.; Lond. "Elec.," Feb. 24.

REFERENCES.

The K. R. Law.—The first part of a mathematical article inquiring into the question of the accuracy of the K. R. law, with special reference to the formulas of Lord Kelvin and Prof. Blakesley. A table is given containing the speeds calculated from these formulas on a basis of the 1882 cable.—Moon. Lond. "Elec. Rev.," March 3.

New System of Charging for Telephone Service.—A reprint of the recent law in Germany concerning telephone charges, a brief notice of which was given in the "Digest," March 11.—Elek. Zeit.," March 2.

Wireless Telegraphy.—An interesting summary of the history of the subject, including the Marconi methods and those depending on earth currents.—Schluckebier. "Archiv. Post. Teleg.," 7, p. 208 and 240.

Submarine Surveys for Cables.—A reprint of the article noticed in the "Digest," March 4.—Bright. "Sc. Am. Sup.," March 18.

Block Signals in Austria.—A short descriptive article.—Kohlfuerst. "Elec. Tech.," Feb. 28.

Miscellaneous.

Printing Without Ink.—A process invented by Green was, according to "L'Elec.," Feb. 25, recently shown in England. The paper is first treated chemically; when it passes over the type, a current of electricity passes through it, discoloring the chemical compound and forming a black spot wherever the paper is in contact with the type.—"L'Elec.," Feb. 25.

Electric Station Steam Heating.

BY I. H. BABCOCK.

Electric power stations include within their walls many possibilities. They furnish current to run machinery, stationary or movable. They light buildings and light the public streets. They are able to heat confined spaces, but unfortunately the cost for heating is so great that, except for very small apartments, it is found to be unprofitable. If they had no other resource, that would practically rule them out from doing a heating business; but they have other resources that can be turned to their pecuniary benefit. In generating current by steam power it is found that the engine can utilize barely 10 to 15 per cent. of the steam passing through. The other 85 per cent. exhausts into the atmosphere.

Many of the electric companies are now piping this exhaust steam out through the streets of cities and villages for heating all kinds of buildings. They find that the income from this more than pays coal bills at the station for the entire year. This new branch fits in well with their regular business, as only the same office force and force at the station is required. The question has been raised as to whether water would not be a more satisfactory conveyor of heat than to pipe the steam direct. Some years ago such a plant was installed in Boston at very great expense. But the sanguine expectations of the promoters were doomed to disappointment. It was soon found that the hot water pipes were short lived, and, besides, powerful pumps were required to circulate the water to the top stories of high buildings, and large and expensive tanks for reheating the return water. The enterprise was doomed to disastrous failure from the start. Then in hot water heating about 50 per cent. more radiation is required, which adds to the expense of fitting up buildings.,

In all up-to-date towns now there is a large amount of steam heating by individual boilers. These buildings can come on a steam line without changing their radiation; but to heat with water it would necessitate new radiation and new piping throughout. As a conveyor of heat, steam cannot be approached by any other agent, except electricity. It moves rapidly and requires no propelling force except that accumulated in the boiler which generates it. Simplicity in any business always tends to economy, and it is never advisable to sacrifice this for complicated devices unless something is clearly to be gained by such a change.

The Sale of Electrical Supplies by Hardware Houses.

At the beginning of the present year the question was raised in the hardware field as to the opportunities presenting themselves to local hardware houses to handle electrical supplies and apparatus in small towns and cities below, say, 50,000 inhabitants. One of the chief writers on the subject, a hardware man, insisted that an undeveloped business was awaiting his fellows in places where the population was not large enough to support a regular electrical supply house; and he argued that it would work in very well with a trade in bicycles, the call for electrical adjuncts being loudest when the market for wheels was dull. He argued that the whole thing was easy, chiefly because the National Underwriters' rules were open to all, "and this, in connection with their list of electrical fittings, will prove a sure guide to the buyer until he can rely on his own judgment."

The point thus raised has been deemed important enough to bring to the attention of leading houses in the electrical supply trade, and a number of interesting communications have been received on the subject, some of which we are at liberty to use. Other opinions are invited, both as to whether consumption of electrical goods can be thus stimulated and developed where it now languishes, and also whether the electrical art has been so simplified that its knowledge can be part of the wisdom doled out at the village grocery.

Mr. Thos. I. Stacey, secretary and treasurer of the Electric Appliance Company, of Chicago, writes us as follows: "The writer of that article has overlooked the fact that electrical supplies are not usually sold direct to the consumer, as is hardware. A man does not buy a piece of electrical apparatus as he would buy a hammer or saw, or a pound of nails. Electrical material usually requires some electrical knowledge for its installation, and the purchase of electrical material by the consumer usually resolves itself into a contract for some kind of construction work. In this respect the electrical business in the smaller towns and cities can be better compared with the plumbing business than with hardware. The writer believes that a man of ordinary business ability and with a reasonable amount of electrical knowledge is in better shape to handle the electrical business of a small town or city, as a contractor, than is the large hardware dealer of that town. We have quite a number of customers among the hardware trade who carry electrical supplies, but we do not know of a single case in which the small contractor or construction man of the town does not do several times the amount of electrical business that the hardware house does."

The H. C. Roberts Electric Supply Company, of Philadelphia, has this to say on the subject: "We do not think that the writer of the article in question has a wide enough experience in the electrical business to realize that we could put a good electrical clerk into any hardware store and let him look over the stock, and that he could tell the use of nearly every article in the store. We are positive, on the other hand, that no hardware clerk would go into a large supply store and name the use of one-tenth of the articles there. We admit, however, that the hardware business is one of the most intricate, and think the hardware man has enough to do to puzzle his brains without going into the electrical supply business. From our point of view, no business is more complicated or has more new articles added to it in a year, or has so many changing costs. The writer of the article in question is not acquainted with selling electrical goods; all towns of any size are covered thoroughly by the traveling men of the jobbers of the large cities. Many of the customers of the electrical supply house are small hardware men, but it does not follow that the hardware jobber could sell him the goods, as he would not be in a position to buy them at a figure which would allow him to compete with the electrical supply house."

The Manhattan Electrical Supply Company, of New York city, is interested in the subject, and its manager, Mr. J. J. Gorman, takes a broad view of the situation. He says: "Some of our most satisfactory customers to-day are hardware dealers, and we are constantly striving to increase the number. We decided several years ago that hardware dealers in small cities and towns were the best source for the distribution of electrical supplies. We think in a few years nearly every hardware dealer outside of the larger cities will carry a stock in connection with his hardware line."

A large concern in this part of the country, and universally known, says: "Our house has for some time past been making special efforts to interest the hardware trade throughout the country in the matter of having electrical departments in their stores, as we long since came to the conclusion that this would be a proper outlet for electrical goods."

The Royal Electric Company's New Alternator.

The design of machinery in general, and of electrical apparatus in particular, constantly tends towards greater solidity, simplicity, and the elimination of small detail attachments. The alternating-current dynamo is an improvement in this respect over the direct-current, and of the alternating-current types the revolving armature is inferior in this regard to the revolving field, and that in turn is inferior to the inductor type. There are now quite a number of dif ferent classes of the latter type, which, simple as it is, gives considerable scope for the ingenuity of the designer, a fact which will be evident from the improvements in the design of the machine of this type built by the Royal Electric Company, of Peoria, Ill.

Of the accompanying illustrations, Fig. 1 shows a 150-kw genera-

tor assembled. It exhibits the usual features of the inductor type, namely, the absence of all collector rings, brushes or exposed connections of any kind, and the concealment and protection of all parts of the machine, the pulleys and bearings excepted, within the yoke ring, and the end plates fitted to it. Fig. 2 shows the frame of the external stationary armature without coils. From this it is evident that the machine is of that class of inductor dynamos in which both polarities of the rotor are fitted with poles opposed by wound armature teeth, as distinguished from that class in which there is but one ring of armature teeth, the other polarity being a continuous ring, untoothed on the armature side and without poles on the rotor side. The slots are approximately the same width as the teeth, giving ample room for the armature coils. The external ring is of cast iron, and the laminated teeth are attached to it by means of cast steel end plates of a toothed contour. There are two armature teeth for each pole of the rotor, and the dimensions are so chosen that the reluctance of the magnetic circuit is the same for all positions of the poles.

The space between the two rings of teeth is occupied by the field-exciting coil, shown removed in Fig. 3. This has an external diameter smaller than the internal diameter of the armature teeth and fits down between the two rings of poles of the rotor, thus giving it a minimum ohmic resistance and waste of energy per ampere turn. The coil is short and deep—that is, of many layers and few turns per layer. It is wound upon a spool, the cylinder of which is of heavy copper to cut down the inductive rise of pressure on opening the field circuit, the sides of the spool being perforated to allow the ventilation of the field winding by the currents of air set in motion by the poles of the rotor. Fig. 4 shows the frame with both the field and armature windings in place, and the rotor removed. The armature coils are joined by connections, easily accessible at their outboard ends, and may readily be connected up in series or parallel to give one or more of many different voltages. A white marble terminal board placed on one side of the machine is fitted with a cover to prevent accidental contact with the high-voltage terminals. Fig. 5 represents the inductor mounted between the bearings on the base of the machine. This rotating element is divided into three parts, one the central cylindrical core and the other two the rings carrying the laminated poles. These three parts are bolted together securely, and by simply loosening the bolts either ring may be removed to get at the corresponding armature windings or to remove the field-exciting coil. The poles are laminated to prevent the foucault currents which would otherwise be set up by the armature teeth.

The double ring of poles gives some mechanical, as well as electrical, advantages. The weight is concentrated at the two points nearest the journals, the axial pull of one ring of poles neutralizes that of the other, and the division of the armature windings gives a greater radiating surface, resulting in a lower temperature rise for the same current density. The division also allows the machine to be very simply transformed from a single to a two phase generator. This is accomplished by simply shifting one of the pole rings relatively to the other, so that the poles have a staggered relation, and dividing the circuits of the two rings of armature teeth. One of these then generates an electromotive force displaced in phase from that of the other. The necessary holes are provided in the centre core of all machines, so that this change can be quickly made. The magnetic density throughout the whole circuit is low, no point running above the bend of the magnetization curve. The air gap between the rotating and stationary elements is comparatively large, and although this condition increases considerably the cost of manufacture it has been adopted for mechanical reasons, as well as to reduce the armature reaction and give close automatic regulation without the complication of a rectifier and compound winding. The regulation obtained is within 2 to 7 per cent., depending on the size of the machine.

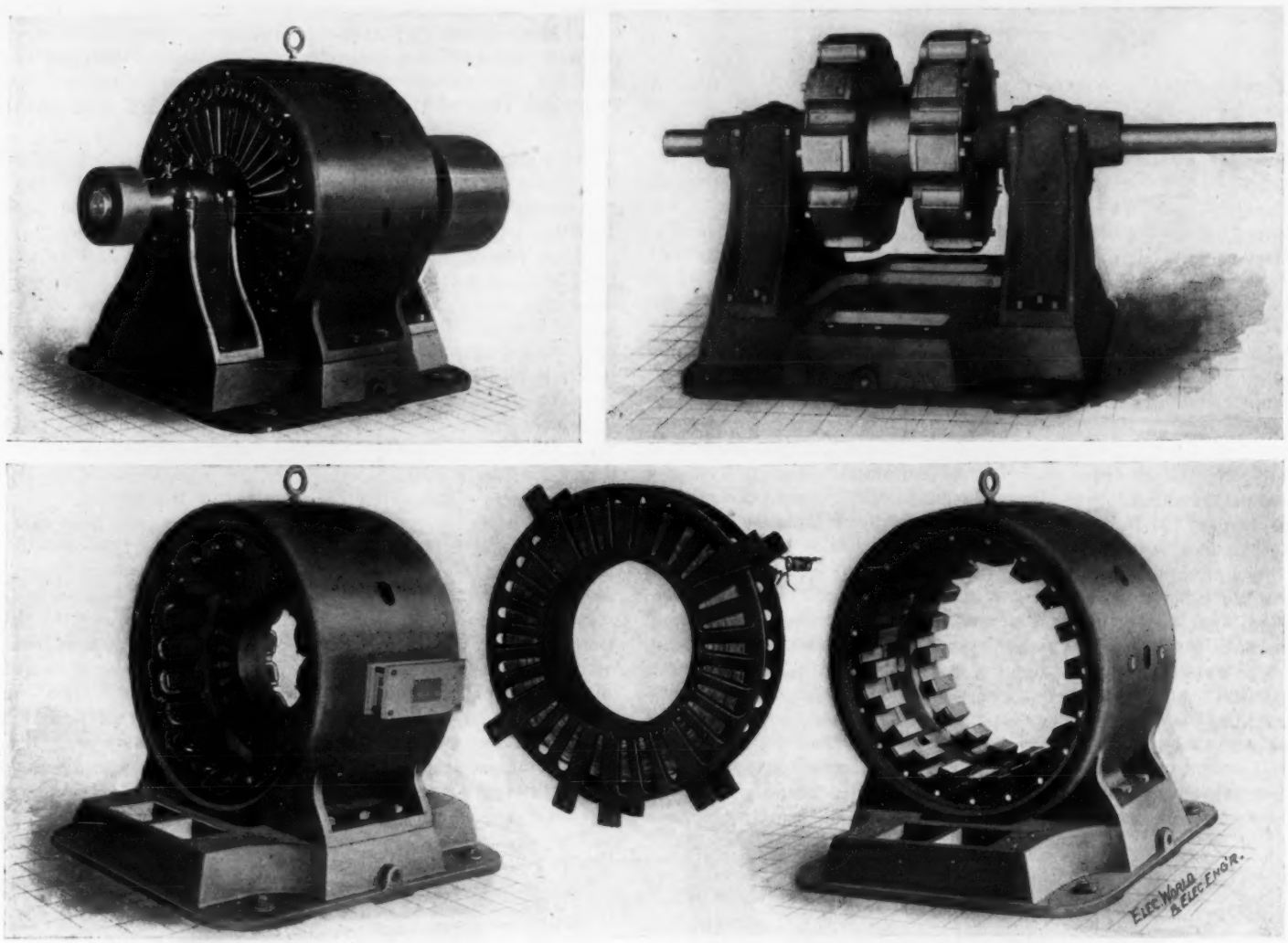
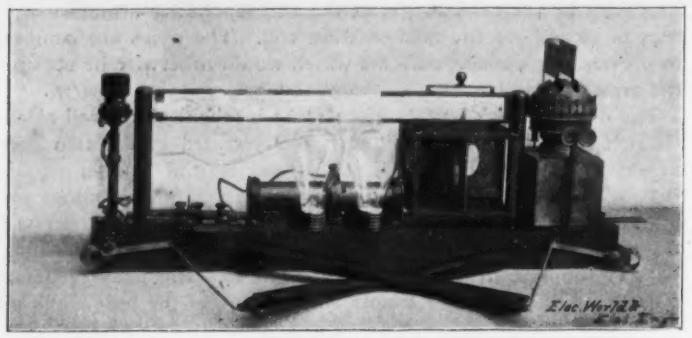


Fig. 1.—150-kw Generator. Fig. 3.—Exciting Field Spool. Fig. 5.—The Inductor.
Fig. 4.—Frame and Windings. Fig. 2.—Frame of External Stationary Armature.

ROYAL ELECTRIC COMPANY'S NEW ALTERNATOR.

The Deshler-McAllister Portable Photometer.

The photometer illustrated herewith has been designed especially for the manufacturer, buyer, seller and user of incandescent lamps, to enable them to rapidly and accurately ascertain how nearly such lamps approach standard rating. To meet this object the instrument has been put into thoroughly practical form, and being designed for only one class of work it has been possible to attain a maximum of accuracy.



Portable Photometer.

The working standard of light consists of two oil flames (a duplex burner) of about 30 candle power normal rating. In practice the flames burn below the normal rating, giving a steady and constant standard light for hours without readjustment. It is readily adjusted on the instrument by photometrical comparison with a regular standard laboratory tested incandescent lamp, temporarily connected in the socket, provided for the purpose; hence, the "working standard of light" may be re-standardized as often as found desirable, without materially affecting the value as a standard of the laboratory tested incandescent lamp. Since the same end of the photometer is used in standardizing the instrument with the "test" lamp and in taking actual readings, but one set of pressure and current-reading instruments is necessary, one person being thus enabled to operate the entire photometer. To still further adapt it to ordinary station requirements, this photometer, though having a regulation extension of 5 feet when unfolded, "knocks down" into a compact package only 24 inches long by 6 inches wide and 9 inches high, so that, when not in actual use, it may be stored away.

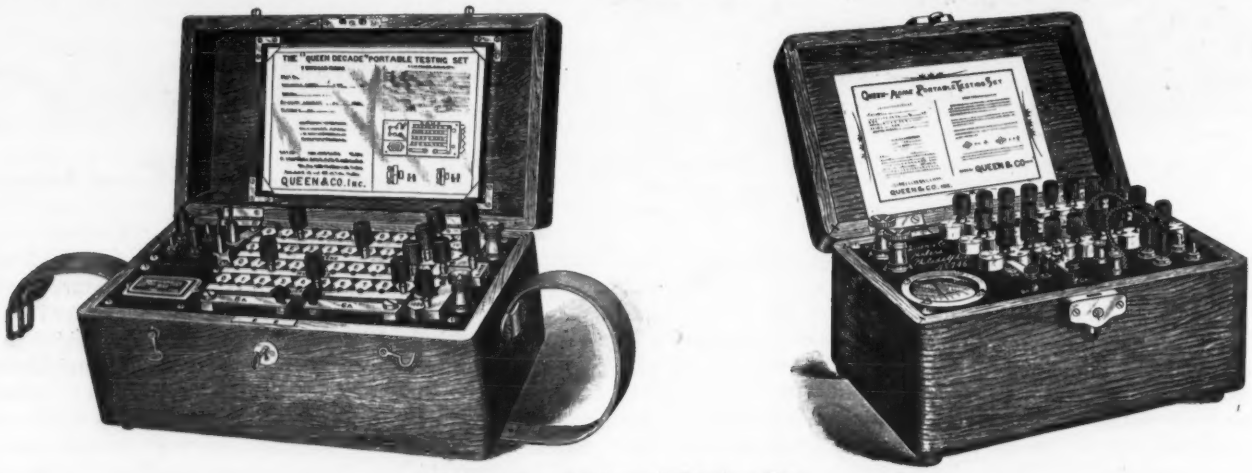
The photometer is made in two styles, one for central station use and the other for the more extensive requirements of the incandescent lamp salesman. The central station pattern has a German silver slider resistance, giving a variation of about 8 volts at 110 volts' pressure. Four laboratory tested standard incandescent test-lamps are supplied with each instrument. The scale, which is direct-reading, has a measuring range of from 7 to 34 candle power. The salesman's photometer is, in its general features, similar to the central station instrument, the main point of difference being that it is somewhat lighter, its weight complete being 12 pounds. Its slider resistance gives a variation of about 16 volts at 110 volts' pressure. It is provided with an adapter to fit Westinghouse or Sawyer-Man bases. The central station photometer has socket connections for testing lamps with Edison and Thomson-Houston bases.

These photometers are made by the Newark Ornamental Iron & Sign Works, 84-88 Mechanic Street, Newark, N. J.

Improved Portable Testing Sets.

The portable Wheatstone bridges manufactured by Messrs. Queen & Co., Incorporated, Philadelphia, have been improved, thereby securing, the manufacturers claim, a range and accuracy heretofore unattainable. The illustrations below represent the "Decade" and "Acme" sets, which are capable of making measurements as follows: .01 of an ohm with an accuracy of ½ of 1 per cent.; .1 of an ohm with an accuracy of ¼ of 1 per cent.; 1 ohm, ¼ of 1 per cent.; 10 ohms, 1-5 of 1 per cent.; 100 and 1000 ohms, each ⅛ of 1 per cent.; 10,000 ohms, 1.5 of 1 per cent.; 100,000 ohms, ¼ of 1 per cent., and 1,000,000 ohms, 3 per cent. With additional battery power these ranges and accuracies may be considerably increased.

The "Decade" and "Acme" sets have the same range, but differ in the manner of use, the former being a "plug in" and the latter a "plug out" bridge. The "Acme" is the lighter and more compact set of the two. It is supplied by the manufacturers to the United States, Japanese and Russian Governments for army and navy service. It is thoroughly portable, and withstands transportation without injury, and requires no preliminary adjustment before using.



"Decade" and "Acme" Testing Sets.

Practical Test of the Murphy Sectional Third Rail System.

The sectional third rail system invented by Capt. John Murphy and owned by the Safety Third Rail Company, of New York, was put through a very interesting and satisfactory trial last week at Manhattan Beach, Coney Island.

The system is laid with the third rail, which may be between the tread rails or on the side, but in this instance is laid between the tread rails, exactly in the middle, in alternate sections, of which one section is what is known as a live rail and the other section is a dead rail. At no time is there any current in the whole length of the power rail unless the car is actually in motion. Only such rail sections as are actually covered by the car become charged. It is, therefore, impossible for any one to be injured by crossing the track, under any circumstances, under any conditions, or at any time. Another feature is that the car and all mechanism are always in full control of the motorman from the front platform.

One of the severest tests that could possibly have been given to any railroad in actual use was made by covering a distance of 25 feet of the track with closely packed snow, heaped to a height of several inches above the track, entirely hiding the three rails from view. This did not in the slightest degree interfere with the operation of the car, which glided through the snow without difficulty at all speeds, was stopped in the snow, and started as well, regardless of the obstructed condition of the track.

Another portion of the track was covered with dirt, entirely hiding the three rails, upon which buckets full of water were poured, making a combination of mud and water. This did not in the slightest degree interfere with the operation of the car.

The live rails obtain their power through the Murphy switch, which is so arranged that when the motorman from the front of the car sends the current through the shoe on the rail connected with the switch it automatically opens it and permits the current to enter

the rail and makes it alive until the second shoe of the car has left that portion of the track. The result is that even what is ordinarily a live rail becomes dead as soon as the car has left it. The safety third rail practically demonstrated also that the line leakage at no point exceeded 7½ per cent.

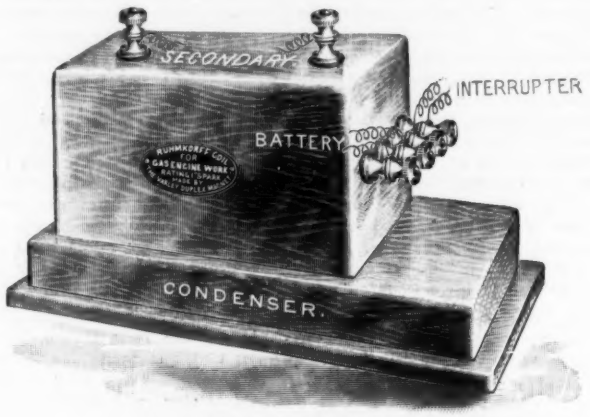
As previously stated, the owner of the Murphy system and patents is the Safety Third Rail Electric Company, of which Mr. Emerson McMillin, of 40 Wall Street, is the president. The offices of the company are at 5 Beekman Street, and Emerson McMillin & Co., of 40 Wall Street, are the fiscal and transfer agents of the company.

The present trial was the first that has ever taken place of this system anywhere practically, and was an immediate success.

Among those present were: Capt. John McLeod Murphy, inventor of the system; E. V. Baillard, his assistant; Emerson McMillin, Emerson McMillin, Jr.; William M. Keepers, of Hartley & Graham; David F. Halstead, R. H. Beach, of the General Electric Company, and Mr. Louis Steckler, counsel for the company, all the above named gentlemen being directors of the company; Mr. C. M. Wicker, of H. B. Hollins & Co.; Talbot J. Taylor, of Talbot J. Taylor & Co.; Professor Oldrini, representing the Corbin Banking Company; Ernest W. Cooke, of the International Hydraulic Company; J. Lewis Byrom, of Manchester, England; George Carey, Alexander Beach and Renwick. A collation followed at Minden's Hotel, where Captain Murphy was heartily felicitated on his seven years' work and his success.

A Ruhmkorff Coil for Gas Engine Ignition.

The accompanying illustration gives a perspective view of a Ruhmkorff coil, manufactured by the Varley Duplex Magnet Company, 138 Seventh Street, Jersey City, N. J., for use in connection with gas and gasoline engines. These coils are specially built to



Ruhmkorff Coil.

give a heavy spark, from 1 to 1½ inches, with an e. m. f. of from 4 to 6 volts. When the terminals of the secondary coil are separated by a space of 3-32 inch a very intense flame is produced and the ignition of the gas is positive. The make-and-break contact is outside of the engine cylinder.

The Varley Company claims that this coil has many points of superiority over foreign coils, which have been used heretofore in this country in gas engine work. It is thought that gas engine builders will find it advantageous to adopt the the Ruhmkorff coil for ignition purposes in place of the ordinary method of accomplishing the same result.

A New Type of Outlet Bushing.

More troubles occur at outlets than at any other point in a house wiring system, owing to the ordinary bushings being frequently displaced by plasterers, lathers and other workmen. Mr. Jacque L. Morgan, city electrician, Kansas City, Mo., has devised an outlet bushing which is intended to avoid the troubles referred to and their attending dangers. This bushing, which has been approved by the fire underwriters, is made of the best porcelain, and its use insures a safe and substantial job. After it has been once nailed in position it cannot be displaced by the workmen.

A view of a bushing is shown in Fig. 1; the method of applying the bushings at outlets is illustrated in Fig. 2.

The bushings hold the wires securely apart, and at a safe distance from the pipe, in the case of a combination fixture. Owing to the

Fig. 1.—Bushing.

simplicity of installation a saving of both time and money is effected, besides securing safety.

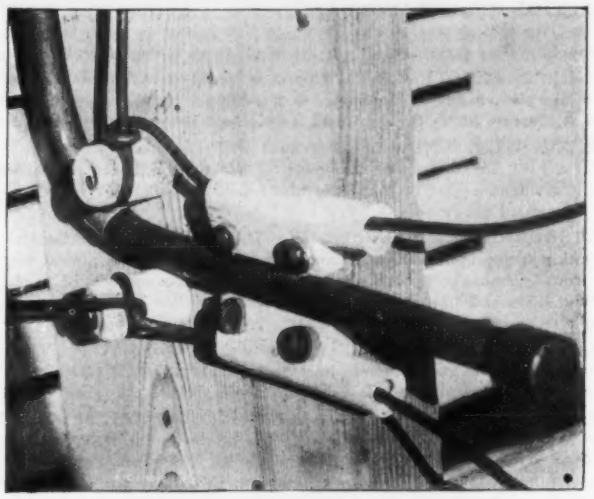


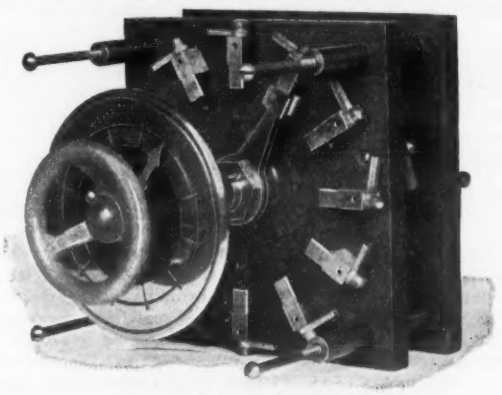
Fig. 2.—Applying Bushing at an Outlet.

The dimensions of the bushings are: Length, 3¾ inches; inside diameter, ⅜ inch; outside diameter, ¾ inch.

An Improved Western Electric Voltmeter Switch.

The instrument illustrated herewith is the new Type F instrument switch manufactured by the Western Electric Company of Chicago. This switch has a positive knife contact, and is designed to be mounted on the rear of the switchboard, and to be controlled from the face of the board by a hand wheel and index plate. The points of opposite polarity are mounted on separate slabs of white Italian marble and are easy of access for connecting up.

Where current readings in a number of circuits are desired, and economy of cost and space must be considered, an ammeter of the



Front View of Switch.

external-shunt type, with several shunts, may be used to advantage. Such instruments are furnished in standard makes and give excellent results, providing a switch be used in the various shunt circuits having a negligible contact resistance. The Type F instrument switch, of which Fig. 1 shows a front view, is especially designed and adapted for this service.

NEWS OF THE WEEK.

Financial Intelligence.

WEBSTER, MASS.—The Webster & Dudley Street Railway Company is bonding its road for $50,000.

UNITED TRACTION & ELECTRIC COMPANY, of New York, has declared a dividend of 1 per cent.

THE OTIS ELEVATOR COMPANY has declared a quarterly dividend of 1½ per cent. on its preferred stock, payable April 15.

THE TWIN CITY RAPID TRANSIT RAILWAY COMPANY has declared a quarterly dividend of 1¾ per cent. on its preferred stock, payable April 1.

SIOUX CITY, IA.—The Central Traction Company has given a trust deed to the Sioux City Safe Deposit & Trust Company to secure an issue of 5 per cent., five-year bonds for $30,000.

THE CENTRAL UNION TELEPHONE COMPANY, which operates under Bell patents in Illinois, Indiana, Ohio and Wisconsin, will issue at once $6,000,000 5 per cent. bonds for betterments.

TRACTION STOCKS INCREASED.—The International Traction Company increased its capital stock from $85,000 to $15,000,000, and the Havana Electric Railway Company increased its capital stock from $5,000,000 to $10,000,000.

GENERAL ELECTRIC COMPANY is credited with a business of $17,000,000 last year, a net of $3,000,000, and earnings, therefore, available for dividends at the rate of 15 per cent. To maintain 6 or 8 per cent. should be easy.

BOSTON WEST END.—In accordance with the provisions of the lease of the West End Street Railway Company to the Boston Elevated Railway Company, a dividend rental of $1.75 per share will be paid to West End common stock of record on April 1.

PITTSBURG BELL TELEPHONE.—The directors of the Central District & Printing Telegraph Company have voted to increase the capital of the company from $3,000,000 to $4,000,000. The additional $1,000,000 will be used for making extensions and improvements.

BELL DIVIDEND.—The American Bell Telephone Company has declared its regular quarterly dividend of $3 per share, payable April 15. The company does not declare extra dividends in March. The annual meeting of the company will be held March 28, at Chipman Hall, Boston.

THE INTERNATIONAL STEAM PUMP COMPANY, of which note was made last week, has been organized in the office of the New Jersey Corporation Agency, in Jersey City. Most of the prominent steam-pump manufacturers in the United States are in the combination. The new company has a capital of $27,500,000. The preferred stock will amount to $12,500,000, while there will be $15,000,000 in common stock.

THE METROPOLITAN STREET RAILWAY, New York, has been acting very well, buyers being on hand whenever the price eased off materially. The directors will meet this week on the first day when a quorum can be secured. There is much curiosity as to whether President Vreeland will have any announcement to make in regard to rights after this meeting, or will wait for a special meeting early in April. The insiders predict 300 for Metropolitan this spring.

MICHIGAN TELEPHONE COMPANY.—January and February increases of subscribers made by the Michigan (Bell) Telephone Company would indicate an increase in gross earnings, if continued during the year, of $400,000, or total gross earnings of $1,000,000. After deducting fixed charges and expenses there would remain applicable for dividends $150,000, or 6 per cent. upon the issued capital stock of the company. The company's dividend for the quarter ending March 31 will probably be 1 per cent., and that rate continued quarterly during the year. The listing of the Michigan company's stock on the Boston Stock Exchange, will take place as soon as certificates can be engraved.

THE BALTIMORE CONSOLIDATION.—Messrs. Brown Brothers & Co. are offering for subscription at 102½, and accrued interest, $11,000,000 first consolidated mortgage 4 per cent. fifty-year gold bonds of the United Railways & Electric Company, of Baltimore. The bonds are secured by a first mortgage on the property and franchises of the company, embracing all the passenger railways in the city of Baltimore and vicinity. Of this issue $4,634,000 is reserved for betterments, improvements, extensions and consolidation expenses, and the remainder is to be used in payment for the properties bought and to retire divisional bonds, debentures and certificates of indebtedness.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—The sixteenth annual report of the New York & New Jersey Telephone Company, recently published, shows that 1898 was a prosperous year to the stockholders of that concern. The earnings over operating expenses are placed at $625,000.87, the gross earnings being $2,058,477.21. The treasurer shows resources of $9,048,413.26 and a surplus of $1,710,342.61, exclusive of $116,560,, reserved for January dividends. Between 1897 and 1898 the gross earnings increased $268,190, and the operating expenses $196,656. Last fall the company increased its capital from $5,000,000 to $8,000,000, and made a new bond issue at par to the stockholders amounting to $1,165,500. The investment in plant amounted to $885,918, much of which was expended in subway construction and putting wires under ground.

PEOPLE'S COMPANY, OF NEWARK, N. J.—As a result of the deal by which the electric light plants of Newark and other cities and towns in East Jersey are to be absorbed by the newly organized United Electric Company, there was a decline in the value of the stock of the People's Light & Power Company, of Newark, the reduction being over 7 points, or from 132 down to 124.50. There was, however, not much sold at the reduced figures. The surplus earnings of the People's Company for the last quarter were $97,600, and a quarterly dividend of 1¼ per cent. was declared recently, amounting to $62,000, so that a balance of $35,100 went into the treasury. At this rate the surplus earnings would be $390,400, and the dividends at 5 per cent. per annum on $5,000,000 of stock would be $250,000, while $140,400 would go into the treasury. It is upon this showing that stockholders oppose the consolidation, although their wishes will not prevail, as a good majority of the stock is pledged to it.

NOT EARNED OUT OF PROFITS.—An early dividend is expected to be declared to stockholders of the Electrolytic Marine Salts Company. All the outstanding stock of the company has been turned over to the committee, with the exception of 21,500 shares, and it is expected that this stock will soon be deposited. The committee has now in its possession $387,000 outside of the company's plant and supplies. This amount includes $75,000 which has been returned by Rev. P. F. Jernegan, who sent in this amount in securities, selling at a premium of $12,000. There were $30,000 Chicago, Burlington & Quincy bonds and $25,000 Rio Grande Western bonds. In the return of this box of securities, with the key from abroad, Mr. Jernegan asked for no protection, simply stating that the money belonged to the stockholders, and requesting that it be disbursed to them as expeditiously as possible. The first dividend to be declared will probably amount to 30 per cent., with a possible later dividend of 5 per cent.

"AUTOMOBILES" IN PHILADELPHIA.—The Philadelphia "Times" of March 18 quotes the activity there in automobile stocks as follows: Yesterday was a "specialty" market in this city. We would not be far wrong in calling it an "automobile" market, for fully one-third of all the transactions were in Pennsylvania Vehicle, Electric Vehicle and General Electric Automobile. The demand for these stocks was remarkable, and the higher prices rose the heavier, more persistent appeared to be the buying. Pennsylvania Vehicle was the first feature, and over one-half of the outstanding common stock was dealt in between prices ranging from 20 to 21⅝. It sold at 18¾ at the close on Thursday. After the close yesterday 22 was bid for the stock, with sellers holding off for higher prices, which they seem likely to get. Electric Vehicle advanced 3 points to 113. Several thousand shares of General Electric Automobile were dealt in between 13½ to 15½. There was an apparent effort to keep the price down, but the buying would not be gainsaid. After the close of the market 16 was bid for the stock, but, as in the case of Pennsylvania Vehicle, sellers at that figure were not to be found.

THE WEEK has been full of interesting features, and while it began with dullness and heaviness, may be said to have closed with many signs of firmness and strength. The industrials furnished the chief sensations, as there was little new in railroads, telegraphs, etc. The bank statement was satisfactory. Net railroad earnings were 11½ per cent. better for January than in the same period of 1898, and are reported good at date; business failures are below the level of last year, and the indications of jobbing and retail trade all over the land are most encouraging. Iron and steel lead the market in activity and stiff prices, but there are many advances recorded alike in prices and wages. Cereal prices have been weaker on good crop statements. Western Union closed the week at 94⅞, and General Electric at 117½. Metropolitan Street Railway was steady at the high figure of 255-6. In Boston, American Bell Telephone held up to 344½, and West End Railroad to 94. In Philadelphia, Storage Battery has been strong, and it is reported that the new interests will offer to buy at over 200, with 4 per cent. bonds. It closed the week at 162. In New York city, the parent Electric Vehicle stock closed at 113½ common and 130 preferred.

NEW ENGLAND TELEPHONIC OUTLOOK.—The financial telephonic outlook in Connecticut is thus discussed by the New Haven "Register": Southern New England stock is at present tied up among the holders, and little, if any, is being sold to the public, or is being even privately exchanged. For some time the figure has held at 126½, and during the past few weeks sales have been effected at those figures, though few have been chronicled at that. During the past weeks when the agitation by rival companies has been going on, the Southern New England stock has held remarkably steady, with few, if any, efforts to sell. During the past few days there have been rumors of offers of the stock at 124-125½, but no authoritative advices of such a sale can be obtained. It seems to be a fact that Southern New England telephone stock has not suffered in the least from the opposition companies, a state of affairs that is causing much wonderment among those interested in the rival companies. Several new elements are about to enter the field, however, if the assurances of the gentlemen interested can be relied upon. The one that is most noticeable at present is the entrance into Connecticut of the new Citizens' Telephone Company in Meriden. This company is capitalized at $30,000, backed by Meriden gentlemen, and has secured permission to construct its system in that city. There is every reason to believe that the Meriden company will succeed in establishing itself, and in securing an exchange of not under 600 instruments.

Special Correspondence.

NEW YORK NOTES.

MOORE ELECTRICAL COMPANY has opened, at its offices, 50 Broadway, Room 17, a Moore vacuum tube parlor, which is lighted by tubes every day from 1 until 5 P. M., using the system of Mr. D. McFarlan Moore.

LECTURE ON LIGHTNING PHENOMENA.—Mr. W. J. Jenks gave a lecture before the department of electricity, Brooklyn Institute of Arts and Sciences, on the evening of March 24, on the subject of "Modern Research Into Lightning Phenomena and Building Protection." The lecture was illustrated by lantern slides.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The one hundred and thirty-third meeting of the Institute was held at 12 West Thirty-first Street, on the evening of Wednesday, March 22. A paper was presented by Dr. M. I. Pupin, of New York, on "The Propagation of Long Electrical Waves."

CONSIDERABLE INTEREST is already being manifested in the coming National Electric Light Association convention to be held next May in New York City. Additional interest is taken in this convention in view of the fact that it will be held during the time of the Electrical Exhibition at Madison Square Garden. A large attendance of central station men and manufacturers from the West is assured. A movement is on foot to run a special train from Chicago over the Michigan Central via Niagara Falls, with stop-over there, and thence in connection with the New York Central to New York. The usual convention rates of one fare and one-third on the certificate plan for the round trip will be made.

PHILADELPHIA NOTE.

THE "JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES" for January, 1899, contains, among its contents, papers on "Power and Equipment of Electric Railways," by Messrs. H. H. Hunt and C. K. Stearns, of the Boston Society of Civil Engineers; and a description of an electric railway from Butte to Centreville, Mont., by Francis W. Blackfield, of the Montana Society of Engineers. Both of these papers are illustrated.

SOUTHERN NOTES.

THE SOUTHERN STATES TELEPHONE COMPANY, Norfolk, Va., is making arrangements for the extension of its system.

THE POTOMAC RIVER POWER COMPANY, Fairfax Courthouse, Va., will in the near future establish an electric power plant near Little Falls.

A MUNICIPAL PLANT.—An election will be held in Lexington, N. C., the latter part of March to vote upon the question of issuing $10,000 bonds for the construction of an electric light plant.

THE RICHMOND, VA., TELEPHONE COMPANY, at its recent annual meeting re-elected the following named officers: Mr. John C. Robertson, president, and Mr. Warner Moore, vice-president.

AN ELECTRIC LIGHT PLANT FOR LOUISBURG, N. C.—The North Carolina Legislature has granted the town of Louisburg the privilege of issuing $30,000 bonds for a waterworks and electric light plant.

A NEW TELEPHONE LINE from Clarksville, Tenn., to South Side is to be erected by a company just formed for the purpose. The line will be about 12 miles long, and an endeavor will be made to effect arrangements for connection with the Cumberland Telephone Exchange at Clarksville.

THE CONTRACT FOR THE RECONSTRUCTION of the plant of the Citizens' Electric Light Company, at Houston, Tex., has been awarded to Mr. August Baumbach, of that city. The machinery and apparatus will be supplied by northern and eastern firms. The plant complete will cost about $150,000, but this does not include the extra poles and wire necessary for the proposed extension of the service.

INDIANA NOTES.

THE FRANKLIN WATER & POWER COMPANY, Franklin, Ind., has been granted the contract for lighting the city of Franklin at $75 for each arc light per year.

INCORPORATION.—The Richmond Interurban Electric Railway Company has filed articles of incorporation with the Secretary of State. The company proposes to construct and operate an electric line in Richmond, Centerville, East Germantown, Cambridge City and Dublin.

ELECTRIC POSSIBILITIES AT LAPORTE.—Pittsburg capitalists, represented by Senator Kennedy, are proposing to build an electric railway between Laporte and Michigan City, and ultimately to South Bend, where extensive works are operated by Pittsburg capital. The survey is progressing rapidly. A number of electric lines are now in successful operation in northern Indiana.

WANTS A SET-OFF.—A. B. Irwin, a banker of Rushville, has brought suit against the Co-operative Telephone Company, claiming $1000 damages for cutting off his residence instrument. The plaintiff made repeated demands to have his 'phone replaced, but the company refused to do so, on the ground that plaintiff had failed to pay his 'phone rent. The plaintiff alleged and proved that the defendant company was indebted to him. The court took the matter under advisement.

THE INDIANAPOLIS STREET RAILWAY SYSTEM.—The question of granting a franchise to the new Indianapolis Street Railway Company has become an all-absorbing topic, and the people are thoroughly aroused in the matter. The recent Legislature passed a special act authorizing the city of Indianapolis to contract with any street railway company for a surrender of its existing franchises, and the grant of a new franchise to operate a street railway in the streets of the city for a period not longer than thirty-four years. It provided that the fare cannot be more than 5 cents, with privilege of transfer, and tickets must be sold at the rate of six for a quarter. The company must permit the use of its tracks by suburban lines. The penalty for violation is the forfeiture of rights. Immediately upon adjournment of the Legislature the new company organized by electing as president Mr. H. P. Wasson, a prominent merchant of Indianapolis. Three of the directors are citizens of Indianapolis, two are citizens of Philadelphia, and one of Kansas City. On March 14 the directors and officers held a conference with the city authorities, Mayor and Board of Public Works, with the purpose of agreeing upon the terms of the new contract or franchise. In the meantime public meetings have been held by the citizens, protesting against granting a franchise at this time, and, if it is granted, demanding above all other concessions a 3-cent fare. Petitions have been circulated all over the city and been universally signed asking the Board of Public Works to insist on a 3-cent fare and a franchise not to exceed fifteen years. Later it was rumored that the company had refused to grant a 3-cent fare, and that the Board of Public Works was not insisting on it; thereupon W. F. Smith and F. E. White filed a complaint in the Superior Court asking for a restraining order to prevent the Board of Public Works from granting the franchise until such time as the question could be properly considered. Judge Leathers promptly issued the order, and the board is now enjoined from granting the franchise until further orders from the court. The turn of affairs has created great excitement, and the people are determined to have some voice in the matter.

WISCONSIN NOTES.

THE FOND DU LAC ELECTRIC RAILWAY has been granted a franchise to build, equip and operate an electric street railway system in the city of Fond du Lac.

ELECTRIC RAILWAY EXTENSION.—A franchise has been granted to the Milwaukee Electric Railway & Light Company for the extension of its line to North Milwaukee. It is expected that the extension will be in operation by August 1 next.

MILWAUKEE AS AN ELECTRIC RAILWAY CENTRE.—Milwaukee is now the centre of a great electric railway system. The lines now reach to Kenosha, on the south, and to Waukesha, on the west, not including those in the suburbs. The extension of the Racine & Kenosha line to Chicago and the North Milwaukee line to connect with the Fox River Valley line at Fond du Lac, and possibly thence northward around the western shore of Lake Winnebago through the cities of Oshkosh, Neenah, Menasha, Appleton, down the valley of the Fox River, is contemplated. Connection with Chicago in the near future is certain, since the Chicago line is now under construction and will be ready for operation before long. The Fox River Valley Company now operates a line between Appleton and Neenah, and it only needs connecting links to reach Chicago and Green Bay. It has been estimated that to finish the building and equipment of this line will require an expenditure of $7,000,000. Six to eight power houses will be needed along the line. It is not unlikely that an express and light freight business will be carried on over the road, as well as passenger service.

ST. LOUIS NOTES.

CONSOLIDATION OF ELECTRIC RAILWAYS.—The City Council has passed a bill authorizing the consolidation of the Southern Electric Railway and the Hamilton Syndicate lines; also authorizing the change of motive power on the Broadway line.

TO EXTEND ITS LINE AND ADOPT ELECTRICITY.—The People's Railway will be extended and improved, for which purpose it is the intention to form a new company. The motive power will be changed to electricity, and the third-mortgage bonds of the People's Company will be redeemed with stock in the new company.

THE CENTRAL TRACTION COMPANY, which has been granted a franchise in this city, has decided to build at once the lines authorized by that instrument. At a recent meeting of the stockholders Mr. Jilson J. Coleman was elected general manager and Patrick Calhoun, of New York; Murray Carlton, H. L. Priest, George W. Hunter and F. E. Marshall were elected directors.

PACIFIC COAST NOTES.

TO RETIRE LIGHT AND WATER BONDS.—The city of Tacoma, Wash., expects to spend $100,000 for the purpose of retiring outstanding light and water bonds.

THE WASHINGTON WATER POWER COMPANY, Spokane, Wash., will install additional General Electric generators having a capacity of 2000 horsepower.

EXTENSION OF A TELEPHONE LINE IN OREGON.—The telephone line now in course of construction from Bandon, Ore., to Rogue River will finally be extended to Port Orford.

THE SNOQUALMIE FALLS POWER COMPANY, of Seattle, Wash., has been granted a franchise permitting the distribution of electric power from Snoqualmie Falls in the city of Tacoma.

THE ELECTRIC GOLD EXTRACTION COMPANY was recently incorporated with Bishop, Cal., as the principal place of business. Directors: W. W. Watterson, P. P. Keough, P. Somerville and T. E. Luce. Capital stock, $5000.

TO EXTEND A TRANSMISSION SYSTEM.—The Yuba Power Company, Marysville, Cal., is arranging for a considerable extension of its water-power electric-transmission system. Benjamin, Hunt & Meredith, of San Francisco, are the consulting engineers for the work.

THE CLEAR LAKE ELECTRIC POWER COMPANY has applied for a franchise to transmit electric power in Solano County, Cal. The franchise will be sold May 1. Many unsuccessful attempts have been made to develop the undoubted possibilities of Clear Lake for generating electricity.

FIRE DAMAGE.—The Pacific Power Company, San Francisco, sustained a loss of about $10,000, on March 10, by a fire in the upper stories of its building at 23 Stevenson Street. The electric plant was not seriously damaged, and the motor service from the company's mains was suspended only one day.

TRANSMISSION IN HAWAII.—The Pacific Coast District Agency of the General Electric Company will send engineers from San Francisco to install an electric pumping plant for the Y. & I. Company in the Hawaiian Islands. There will be an electric transmission about 6 miles in length. The islands are now included in the Pacific Coast District of the General Electric Company.

MUNICIPAL PLANT IN ASTORIA.—Astoria, Ore., is again considering the establishment of a municipal electric lighting system. The contract with the West Shore Mill Company will expire May 17. A Council committee will confer with the Water Commission on the subject. It is estimated that a water-power plant having a capacity of 60 arc lights could be installed in connection with the city water system at a cost of $15,000.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

The Telegraph and Telephone.

MARSHALL, IND.—Mr. C. W. Shimel has obtained a telephone franchise in this city.

TRENTON, N. J.—The Munay bill, which was introduced in the Legislature to fix telephone rates, was defeated.

VIENNA, ILL.—The Interior Telephone Company has been formed by H. De La Rue, J. W. Eaton, Jr., and C. H. Gray.

GALLIPOLIS, OHIO.—The Independent Telephone Company, of this city, proposes to establish an exchange at Vinton.

CITY OF MEXICO.—The Mexican Government is extending its telegraph line from Ichmul to Tihusuco, in the State of Yucatan.

DES MOINES, IA.—The Mutual Telephone Company has just added two sections to its switchboard, with a capacity of 1450 connections.

PETOSKEY, MICH.—The Emmett County and Northern Telephone companies have been consolidated, and the entire system will be rebuilt.

NASHVILLE, TENN.—The Cumberland Telephone & Telegraph Company has decided to increase its capital stock from $3,000,000 to $6,000,000.

PITTSBURG, PA.—The Central District Printing & Telegraph Company will build a trunk telephone line from this city to East Liverpool, Ohio.

DELTA, PA.—The Delta Telephone Company has disposed of its plant and franchise to the Highland Telephone Company, of Hartford County, Pa.

CUMBERLAND, MD.—The Davis Coal & Coke Company is extending its private telephone system to Cumberland, where its head office will be located.

ALLENTOWN, PA.—The Lehigh Valley Telephone Company has petitioned the City Council of this place for a franchise to establish an exchange in this city.

LEXINGTON, KY.—A franchise has been granted to the Winchester & Lexington Telephone Company by the City Council to construct its lines in the city.

CHICAGO, ILL.—The Illinois Telephone & Telegraph Company has signified its acceptance of the ordinance recently passed giving the company a franchise in the city.

ALMA, MICH.—The Alma Telephone Company has been formed, with a capital stock of $25,000. Among those interested are G. S. Aldrich, of St. Louis, Mo., and F. C. Brown, Alma.

JACKPOT, KY.—The Jackpot Telephone Company has been incorporated at this place with a capital stock of $70, for the purpose of constructing a telephone line from Clay City to Staunton.

WOONSOCKET, S. D.—The Dakota Southern Telephone Company has been incorporated, with a capital stock of $50,000. The incorporators are Charles M Hopkins, G. Dzlewanoski and Robert S. Vassar.

PEE DEE, N. C.—The Pee Dee News Transit Company has applied for a telephone charter. The incorporators are W. H. Smith and J. I. Dunlop, of Wadesboro, N. C., and J. L. Bundy, of Rockingham.

DUBUQUE, IA.—The Standard Telephone Company has asked for a franchise to establish and operate an exchange in this city, promising to give telephone service at half the rates of the existing company.

NEW HAVEN, CONN.—The Southern New England Telephone Company announces a reduction of rates for single-wire service from $120 to $100 a year. This reduction applies to New Haven, Hartford, Bridgeport and Waterbury.

FREMONT, OHIO.—The Fremont City Council has granted a franchise to Mr. John W. Bath, of Elyria, to establish a telephone system in this city. The work will be commenced at once, and cheaper and better telephone service is promised.

ZANESVILLE, OHIO.—The Zanesville Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are S. M. Winn, J. B. Rhodes, G. H. Southard, A. T. Brennan and J. G. England, all of Zanesville.

JACKSON, MICH.—The Concord Telephone Company has been organized by farmers in Concord township, with a capital stock of $5000. The company has a twenty-five year franchise, and the lines will be extended from Concord to nearby towns.

DECATUR, ILL.—The bondholders of the Citizens' Mutual Telephone Company, of this city, have decided to foreclose on the plant for non-payment of interest. The amount of bonds is $20,000, at 7 per cent. The exchange has been in operation about six years.

ATLANTIC CITY, N. J.—The Delaware & Atlantic Telephone Company has accepted the ordinance as passed by the Council requiring the construction of conduits in which to place its wires. The Pacific Avenue conduit must be completed before June 1 next.

LYONS, N. Y.—The Lyons Telephone Company has installed a 100-drop switchboard, and has fifty telephones in operation. This exchange is connected with one at Clyde. Work is soon to be commenced on the line to Newark, N. Y., a distance of 8 miles.

LYNN, MASS.—The Massachusetts Telephone Company has applied for a franchise. It agrees never to charge any more than $3.50 for business and $2.50 for residence instruments per month. A telephone franchise has also been asked for by "Frank R. Marsh, trustee."

NEW ORLEANS, LA.—The People's Telephone Company, a few days ago, began laying its underground cable system. This is said to be the first underground work south of Memphis. The company expects to have its entire system underground and ready for operation in a short time.

GRAND RAPIDS, MICH.—The Michigan Telephone Company announces that, owing to the fact that it now has 4000 subscribers in Grand Rapids and vicinity, it will be necessary to establish two branch exchanges in this city. Several sites for the new buildings are now being examined.

JAMESTOWN, MINN.—The Northwestern Telephone Exchange Company has secured a right of way between Jamestown and Lamoure, and is now negotiating for right of way between Lamoure and Lisbon. The company will extend its line from Jamestown to Lisbon as soon as possible.

IRWIN, PA.—It is stated that a Chicago syndicate has been trying to secure control of all the local telephone companies in Westmoreland County. It has purchased the Latrobe Company and is now seeking to obtain control of the Greensburg line. In towns where there are no local companies it is the intention to establish systems.

SEWICKLEY, PA.—A franchise has been granted to the James M. Uptegraf Telephone Company. The company agrees to make a maximum annual rate for residences in the borough of $18 and $30 for business houses. For an unlimited service, which includes the territory of Allegheny County, the maximum rate will be $50.

LINCOLN, NEB.—The Legislature has passed a law giving cities and towns the right to regulate telephone rates. It is stated that the passage of this bill was due largely to the efforts of the various independent telephone companies, and that it was fought by the Bell interests. The Bell Company may test the validity of the bill in the Supreme Court.

CLEVELAND, OHIO.—The United States Telephone Company, of this city, which operates an exchange in Ravenna, is trying to secure control of the exchange at Newton Falls. It is the company's intention to obtain control of all the independent lines in this section of the State, and it expects to run lines direct from Ravenna to Niles, Youngstown and to Pittsburg.

HENDERSON, KY.—The Green River Telephone & Telegraph Company has been organized. The object of the company is to do a toll line business in this and adjoining counties where independent local exchanges are in existence. Officers have been elected as follows: President, J. H. Hickman, Owensboro; vice-president, O. W. Rash, Henderson; general manager, H. K. Cole.

HAMBURG, N. Y.—A new telephone company is being organized in this place to give service at a much lower figure than that charged by the Bell Company. The local company proposes to give an all-night service at $12 a year. Among the backers of the new enterprise are Jacob Peffer, John Schoepflin and H. G. Pierce. The Bell Company charges $24 a year, and gives a fifteen-hour service.

INDIANAPOLIS, IND.—At the recent annual meeting of the New Telephone Company the following named gentlemen were elected officers: President, A. H. Nordyke; vice-president, S. P. Sheerin; secretary, H. B. Gates; treasurer, M. B. Wilson. Manager Sheerin says that the company will start out with 4000 miles of telephone line. Lines are now being constructed from Indianapolis to Greencastle, Tipton, Crawfordsville and many other points.

LIMA, OHIO.—The stockholders of the Lima Telephone Company, Lima, Ohio, the independent company, had their annual meeting March 6, and the showing was very satisfactory for the past year. They put in 157 telephones for new subscribers, besides paying for all extensions and improvements out of the earnings, and declare a 6 per cent. dividend, with a surplus left in the treas ury. They intend this year to make it a metallic system and put in the latest improved multiple switchboard.

Electric Light and Power.

NEWMAN, ILL.—The station of the Newman Electric Light, Heat & Power Company was destroyed by fire.

ILION, N. Y.—At the recent election in this city the proposition to establish a municipal electric light plant was carried.

WILLIAMSPORT, MD.—At a recent election in this place the proposition to establish an electric light plant here was carried.

ALBANY, N. Y.—The Senate Committee on Finance has recommended the passage of the bill appropriating $60,000 for an electric light plant for the Capitol.

JACKSONVILLE, FLA.—An election will be held in this city on March 28 to vote on the question of bonding the city for $20,000 for an electric light plant.

MALONE, N. Y.—The electric light contract for this place has been awarded to J. H. Finlay, who will light the streets all night every night in the year with 2000-cp lamps for $44.50 per light.

CAMDEN, N. J.—The Easton Consolidated Electric Company has been formed, with a capital stock of $1,500,000. The incorporators are George H. B. Martin, William H. Jolley and John Walmsley.

YONKERS, N. Y.—The Consumers' Electric Company has been formed here, with a capital of $100,000. The directors are F. A. Stratton, G. M. Curtis, Jr., New York; L. B. Lampman, Coxsackie, N. Y.

EL PASO, TEX.—The Cochiti Gold Mining Company, at Bland, Tex., proposes to build a large electric light plant for the purpose of supplying light and power for the operation of its mills and mines.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Muskegon Electric Railway Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $100,000.

CHICAGO, ILL.—A saloon keeper has been found guilty and fined $75 for tapping the mains of the Chicago Edison Company in front of his place and using the current for the illumination of his saloon.

ST. LOUIS, MO.—The Mountain Water, Electric Power & Mining Company has been incorporated, with a capital stock of $5000. The incorporators are Paul A. Fusz, M. Rumsey, C. Jagels and L. M. Rumsey.

SALISBURY, N. C.—The Yadkin Power Company has been incorporated in this State, by Captain John A. Ramsey, of Salisbury, N. C.; J. Lee Maxwell, M. A. Armstrong and F. E. Boardman, of Knoxville, Tenn.

NEW YORK CITY.—The Knickerbocker Electrical Maintenance Company has been organized in this city, with a capital stock of $10,000. The directors are Louis B. Jennings, W. W. Bonneau and W. G. Cochrane, New York.

NEVADA, MO.—The Missouri Water, Light & Traction Company has been incorporated here, with a capital stock of $100,000. Among the stockholders are J. B. Quigley, S. A. Wight, H. M. Buck, C. M. Shartel and C. F. Strohm.

PUEBLO, COL.—The Pueblo Traction & Electric Company has been in-

corporated, with a capital stock of $500,000. This company is composed of the Pueblo Electric Light Company and the Pueblo Electric Street Railway Company.

NEW EGYPT, N. J.—Paxon's Island Water Power & Electric Power Company has been incorporated by Bassler Boyer, Lebanon, Pa.; A. H. Boyer, Bridesburg, Pa., and Jacob H. Grove, New Egypt, N. J. The capital stock is $100,000.

MALONE, N. Y.—The High Falls Electric Company has been incorporated, with a capital stock of $10,000. The officers are F. D. Kilburn, president; J. H. Abbott, vice-president; M. P. Abbott, secretary and general manager; J. F. Wright, treasurer.

CHARLESTON, W. VA.—Owing to the recent rise in the river, Charleston was almost entirely under water. It was necessary to shut down the gas and electric light plants, and the city was in darkness as a consequence. Much distress resulted from the flood.

DAYTON, OHIO.—The Dayton, Arcanum & Greenville Traction Company has been incorporated at Columbus, Ohio, with a capital stock of $10,000. Among those interested are Edward A. Parrott, L. Disher, Charles W. Dale, Solomon Good, John Good, H. L. Ferneding and J. E. Pierce.

ROCKFORD, ILL.—The thawing out of frozen water pipes by electricity has been tried in this city and has proved highly successful. In one case a 200-foot service pipe was frozen solid and was thawed out in seventeen minutes. The city has decided to thaw out all frozen mains in this manner hereafter.

ORANGE, N. J.—It has been decided by a special Council committee to ask for bids for the building of an electric light plant in connection with the new pumping station at Campbell's Pond. If the bids are satisfactory the committee will advise the Council to carry out the provisions of its report.

SAN BERNARDINO, CAL.—The Southern California Ice Company has been incorporated for the purpose of furnishing ice and electric power. The incorporators are J. C. Beale, Samuel Smith, E. R. Spaulding, G. E. Voorhees, Jr., all of Santa Barbara; H. L. Drey, San Bernardino. Capital stock, $50,000.

STILLWATER, MINN.—Mr. M. J. Mandelbaum and others, of Cleveland, Ohio, have been granted a street railway franchise in Stillwater and an interurban franchise in the Twin Cities. The life of the franchise is twenty-five years, and the company agrees to have the line in operation within fifteen months.

MASSENA, N. Y.—The Massena Electric Light Company has received a franchise to establish an electric light plant here. The streets will be lighted with 1600-cp arc lights on an all-night schedule, at a cost of $65 per light per year, or $55 per light on a moonlight schedule. The village is to have the option of either service at any time.

ALEXANDRIA, VA.—The National Electrical Supply Company has been incorporated, with a capital stock of $25,000. The incorporators are Henry D. Merrick, president; Morell Marean, vice-president; Edwin C. Graham, secretary and treasurer; James B. Lackey, Henry F. Taff, all of Washington, D. C., and A. W. Armstrong, Alexandria, Va.

SYRACUSE, N. Y.—The Syracuse Electric Light & Power Company proposes to make extensive additions and improvements to its plant. The work will involve an expenditure of about $200,000. The Fulton Street plant will be increased in capacity to the extent of 30,000 incandescent lamps. The present station is to be extended by the erection of a three-story brick structure. The new machinery will cost about $100,000.

ROCK ISLAND, ILL.—The People's Power Company will double the capacity of its Moline plant by an addition 100 feet long. New machinery will be installed. The cost of the improvements will be about $60,000. The new building will be fireproof throughout, and will be erected by the Coke & Iron Works, of St. Louis. When these improvements are completed this station will have a capacity of from 5000 to 6000 horse-power.

SPOKANE, WASH.—The Washington Water Power Company is making plans to extend its generating plant during the summer. The demand for current has been so large that the present plant of 3000 horse-power has been worked to its full capacity. An additional 200 horse-power is now contemplated, and it is believed that this will enable the company to meet the demand for some time to come. Another power house will be built north of the present one, on Monroe Street, to accommodate the new equipment.

THE ELECTRIC RAILWAY.

MILLVILLE, N. J.—The Millville & Bridgeton Traction Company will extend its road to Cedarville.

CHESTER, N. H.—A charter has been granted by the Legislature to build an electric railroad from Chester to Exeter.

OSWEGO, N. Y.—The street railway system of this place, which includes the Fulton street railway plant, will be sold on April 11.

COATESVILLE, PA.—There is a project on foot to build a trolley line in this borough. It is estimated that the road will cost about $25,000.

MORRISTOWN, N. J.—The North Jersey Street Railway Company has secured control of the stock and franchises of the Morris County Electric Company.

NEW ORLEANS, LA.—The New Orleans & Carrollton Railroad Company has purchased the property and franchises of the Canal & Claiborne Street Railroad Company.

WILMINGTON, DEL.—It is expected that the new electric railway between Wilmington and Chester will be in operation about April 1. The fare from Wilmington to Philadelphia by this route will be 35 cents.

EDINBORO, PA.—Surveys are now being made for a new trolley line between Erie and Cambridge Springs. The road will cost $350,000 to build. Vice-President Gibson, of the Erie Transit Company, is at the head of the enterprise.

ANN ARBOR, MICH.—Messrs. Thomas D. Kearney and Arthur Brown, of this city, have secured a franchise for an electric railroad to run from Ann Arbor to Jackson. The projectors hope to have the line completed by October 1 next.

NEW HAVEN, CONN.—Mr. J. T. Patterson has been appointed receiver of the Hartford & West Hartford Trolley Company. The receivership is the result of an application of the bondholders to place the road in charge of the State Treasurer.

EVANSVILLE, IND.—A number of Dayton, Ohio, capitalists have organized the Evansville Southern Railroad for the purpose of building electric roads to connect Evansville with a number of neighboring towns. The total length of the lines will be about 15 miles.

DENVER, COL.—The consolidation of the electric and cable street railway lines of this city has been effected, and the new company controlling these properties has been incorporated under the name of the Denver City Tramway Company, with a capital stock of $5,000,000.

UTICA, N. Y.—The Racquette Lake Railway Company, which has just been incorporated, proposes to build and operate an electric railroad from Clearwater to Racquette Lake, in the North Woods. The road is to be built primarily to furnish an outlet for a lumber company.

NEW YORK, N. Y.—It is reported that the Long Island Railroad has practically passed into the control of the Brooklyn Rapid Transit Company, or a syndicate representing it. According to report, it is the ambition of ex-Governor Flower to control all railroads on Long Island.

BOSTON, MASS.—The railroad commissioners have approved the purchase of the Braintree Street Railway Company by the Quincy & Boston Street Railway Company. The change of shares of the two companies is in the ratio of five Quincy & Boston shares for six of the Braintree Street Railway Company.

ST. JOSEPH, MO.—W. E. Montague has applied for a franchise for an electric railway over the highways of Buchanan County. Mr. Montague represents a company organized to build an electric railway between St. Joseph and Kansas City exclusively for passenger traffic. It will be several miles shorter than existing steam railroads.

NEW ALBANY, IND.—An electric railway from this city to Sellersburg, Clark County, Ind., a distance of 10 miles, is one of the future possibilities. It is proposed to carry the products of the fruit and dairy interests in this section, which are extensive. The matter is now in the hands of the Commercial Club, of New Albany.

ELMIRA, N. Y.—The power house of the Waverly & Athens trolley road at Waverly, N. Y., was visited by eleven armed and masked burglars early in the morning of March 13. They blew open the company's safe and secured $120 in money. The three engineers and firemen were bound and gagged by the law breakers, but were afterward released.

AKRON, OHIO.—It is possible that a consolidation will be effected between the Akron Street Railway & Illuminating Company and the Akron & Cuyahoga Falls Rapid Transit Company. The first named company is advertised to be sold by the receiver on March 28, but it is thought that arrangements will be made before then to effect the consolidation.

LITTLE FALLS, N. Y.—The Herkimer & Little Falls Electric Street Railway Company has been granted a franchise to build an electric road from this city to Herkimer, on the north side of the river. It is expected that the line will be in operation by the first of November next. The Utica franchise and the right of way across the Mohawk & Malone tracks at Herkimer have already been secured.

MONTEREY, MEXICO.—A syndicate of Pittsburg, Pa., capitalists is negotiating for the purchase and consolidation of the two street railway systems in this city. The transaction will involve several hundred thousand dollars, and the prospects for the consummation of the deal are looked upon as favorable. If the deal is carried through the new owners intend to equip the consolidated system with electric power.

YARMOUTH, ME.—The Yarmouth Electric Railroad Company has entered into an indenture with the Mercantile Trust Company, of Portland, by which first-mortgage 20-year 4 per cent. gold bonds are to be issued to the amount of $350,000. The mortgage covers all of the property of the road and the amount raised from the bonds will be used in paying existing obligations of the road and its construction and equipment.

WEST CHESTER, PA.—The Montgomery & Chester Electric Railway Company has given a $100,000 mortgage to the Real Estate Trust Company, of Philadelphia, trustee, to secure its bonds. The railway company proposes to extend its line from Pottstown to Phoenixville by way of Limerick Square, Spring City, Royersford and other important places. The road will be eventually extended from Phoenixville to West Chester.

SEA CLIFF, L. I.—The Nassau County Railway Company has been incorporated at Albany, N. Y., with a capital stock of $25,000. The object of the company is to construct an electric road between the Sea Cliff station of the Long Island Railroad and the circle at the upper end of the inclined railway. The directors are William F. Brown, William L. C. Allan, Edward J. Boyle, George A. Hamilton, William J. Hawsor, Matthew J. Keany and J. Hollis Gibson, of Brooklyn, and Louis E. Freeman and Francis L. White, of Summit, N. J.

NEWARK, N. J.—It is reported that an electric railway will be constructed from Newark to Lake Hopatcong via Morristown and Dover. The Morristown Electric Light & Power Company has recently enlarged its electric and steam plant, and this, in connection with the fact that the Dover Electric Light & Power Company has been recently organized, gives rise to the general opinion that these plants are to be used to supply power to the proposed line.

FLINT, MICH.—It is announced that an electric railway will be built from

Flushing to Flint, thence south to Grand Blanc, where branches will be extended east to Evans and Pontiac and westward to Long Lake and Fenton. The total distance is 80 miles, and the estimated cost of the work is $1,000,000. Messrs. A. A. Talmage & Co., of New York, are the grantees of the franchise in this city, and are at the head of the enterprise. A franchise has also been secured in Springfield township.

WHITE PLAINS, N. Y.—A 100-year franchise has been granted to the Tarrytown, White Plains & Mamaroneck Electric Railway Company to build its line on the Boston Road between New Rochelle and Rye. There was much opposition on the part of residents along the Boston Road to the granting of this franchise, and it is stated that every means possible will be resorted to to prevent the building of the line. It is reported that the Union Railway Company holds an option on the Tarrytown company.

ALBANY, N. Y.—The Stillwater & Mechanicville Electric Street Railway Company has decided to extend its line, which will result, if the plans are entirely carried out, in the formation of a line connecting all the important towns between Albany and Lake George. The Stillwater & Mechanicville road extends from Stillwater south through the village of Mechanicville to Waterford. The company will extend its track from Waterford to Cohoes and there connect with the Albany Railway. It is likely that a freight and express business will be carried on.

PRINCETON, N. J.—The Trenton Electric Railroad Company has failed in its efforts to obtain the right of way through Lawrenceville. For this reason the company has withdrawn its request for a franchise to enter Princeton. It is now reported that the Trenton, Lawrenceville & Princeton Electric Railroad, which was recently incorporated, will make an effort to build the road, the franchise for which the Trenton Company failed to secure. It is stated that the Trenton Company's failure to get the franchise was due to the united opposition of the Princeton faculty and the Pennsylvania Railroad Company.

KALAMAZOO, MICH.—Work on the dam of the Kalamazoo Electric Company, in Trowbridge, is progressing rapidly, and it is expected that the dam will be finished by the first of May. Power will be furnished from the electric railway from Kalamazoo to Battle Creek, and an application for power has been received from the Grand Rapids & Kalamazoo Electric Railway Company, which is now making arrangements to build a line between the cities named. The promoters of the electric road to run from Allegan to South Haven have been consulting the power company officials with regard to obtaining power for the operation of its cars.

ALBANY, N. Y.—A new company is to be incorporated under the name of the Columbia & Rensselaer Railway, Light & Power Company. The contract for the construction of the line has been let to Belden & Seely, of Syracuse, and work will commence at once. The road will be one of the best equipped in the State, and it is expected to have the section between Rensselaer and Nassau in operation by fair time in September. The road will run from Rensselaer to Hudson, and in its construction the building of stone bridges and a trestle bridge three-fourths of a mile long will be necessary. The following named companies have been consolidated to form the new company: The Greenbush & Nassau Railway, the Kinderhook Light & Power Company, the Kinderhook & Hudson Railway, the Hudson Street Railway, the Citizens' Gas Light Company, and the Gas & Electric Light Company, of Hudson.

CHICAGO, ILL.—The Chicago Consolidated Traction Company was recently formed by the consolidation of several independent companies. These various companies have individually and severally filed articles of incorporation with the Chicago Consolidated Company. The capital stock of the Consolidated Company is $15,000,000. The component companies, with their capital and outstanding bonds, are as follows:

Companies.	Capital.	Bonds.
North Chicago Electric Railway Company	$2,000,000	$829,000
Cicero & Proviso Street Railway Company	2,500,000	1,893,000
Chicago, North Shore Street Railway Company	650,000	675,000
Chicago Electric Transit Company	1,500,000	1,097,000
North Side Electric Street Railway Company	1,500,000	155,000
Suburban Railroad Company	1,250,000	2,500,000
Evanston Electric Railway Company	1,000,000	130,000
Chicago & Jefferson Urban Transit	2,000,000	206,000
Ogden Street Railroad Company	1,500,000	576,000
Totals	$13,900,000	$8,061,000

LEGAL NOTE.

MOTOR LITIGATION.—Two suits have been begun in the United States Circuit Court for the Southern District of Ohio by the Westinghouse Electric & Manufacturing Company against the Dayton Fan Motor Company, for alleged infringements of the Tesla patents, No. 511,559, granted December 26, 1893; No. 511,560, same date, and No. 401,520, granted April 16, 1889.

PERSONAL NOTES.

MR. ANTONIO ULLOA, chief of the Federal telegraph offices in the territory of Tepic, Mexico, has been appointed telegraph inspector for that district, with headquarters in Mazatlan, Mexico. Mr. Joaquin Perez, of San Blas, has been appointed to fill the vacancy caused by Mr. Ulloa's promotion.

MR. E. H. JOHNSON, vice-president of the Sprague Electric Company, started for Europe on Wednesday by the St. Louis, to stay abroad a long time, promoting the important interests that he has there of a personal nature in the electrical field. He will, while in England, make his headquarters at the Hotel Cecil, London.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, has just returned from a prolonged trip through the South and the West Indies, including Cuba, the Bahamas, etc. Mrs. Wheeler accompanied him, and the trip was largely for rest and recreation; but Dr. Wheeler has not altogether neglected business opportunities, and has secured some very important orders.

Trade and Industrial Notes.

PAUL HOENACK, expert mechanician in electrical model and other work, has removed from 191 Worth Street to 108 Park Row, New York.

MESSRS. ZIMDARS & HUNT, 127 Fifth Avenue, New York, have issued an eight-page folder, giving illustrations of some of the high-grade knife switches manufactured by them.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., has opened an office in New York city, at 141 Broadway, under the management of Messrs. McClane and Hamilton.

THE WESTERN ELECTRIC COMPANY, prior to the recent rise in copper, greatly increased its stock of rubber-covered wire, and is prepared to meet the demand of the spring trade with reasonable prices and prompt shipments.

THE FREEPORT GENERAL ELECTRIC COMPANY, Freeport, Ill., was placed in the hands of a receiver on March 11, on the application of several bondholders, who filed a bill alleging that the company is insolvent and unable to pay $78,500 bonds held by them.

REMOVAL.—The Knapp Electric & Novelty Company will to-day move its office and factory from 47 Warren Street to the new building at 125 White Street, near Centre, New York city. Its facilities for turning out work in the new quarters will be double those of the old.

MESSRS. JENKINS BROTHERS, New York, have issued their 1899 catalogue of valves of all kinds, damper regulators, injectors, and other steam specialties. The magnetic lamp holder, which is a very useful device in machine shops, is also described and illustrated in the catalogue.

MESSRS. BRYAN & HUMPHREY, consulting mechanical and electrical engineers, St. Louis, Mo., on March 15, removed their offices to 706-707-708 Lincoln Trust Building. The firm is in excellent shape for professional and expert work in mechanical, steam, hydraulic and electrical engineering.

THE STANDARD UNDERGROUND CABLE COMPANY, of Pittsburg, Pa., is supplying 16,000 feet of lead-covered insulated telephone cable on an order from the Japanese Government. This is additional to the order for 40,000 feet of insulated wire for an overhead cable which the company has been working on for some time.

HIGH INSULATION LINE MATERIAL.—Mr. Fred M. Locke, Victor, N. Y., has just issued an illustrated catalogue of his porcelain and glass insulators, steel pins, break arms, side brackets, ridge irons and line materials of all kinds for high-voltage power transmission, electric light, street railway, telephone and telegraph lines.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, has just issued its 1899 catalogue of fan motors. The company manufactures desk and ceiling fan motors for both direct and alternating current. Various designs of fans of these two classes are well illustrated. The company is also manufacturing a line of column fans.

THE BRYANT BRACKET WEATHERPROOF SOCKET, which is supplied with a brass cap with either ⅛-inch or ⅜-inch thread, will undoubtedly find a large demand. This socket has the advantage of being grooved to take a special 2¼-inch shade holder. The Electric Appliance Company, Chicago, is carrying a stock of these goods.

ELECTRICAL NOVELTIES WANTED.—Messrs. A. H. Belo & Co., publishers of the Dallas "Morning News," Dallas, Tex., are erecting a modern newspaper building, and desire information regarding novel electrical devices—any novelty that will attract attention. There is a chance here to meet the ideas of this enterprising paper.

THE HYATT ROLLER BEARING COMPANY, Harrison, N. J., describes and illustrates, in its literature, the Hyatt flexible roller bearings for reduction of friction on all kinds of machinery. It is claimed that these bearings save 25 per cent. to 60 per cent. of the friction load, according to the class of machinery, the load, size of bearings, etc.

MR. GEORGE L. CRAGG has become associated with Mr. Charles A. Brown, under the firm name of Charles A. Brown & Cragg, 1450 Monadnock, Chicago. This firm will give special attention to patent, trade-mark and copyright litigation, and to the soliciting of United States and foreign patents. Mr. A. L. Lawrence is associated with the firm.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., has an elaborate assortment of Maxstadt fuses and carbon lightning arresters of every design, such as are in demand at the present time. It is constantly increasing its stock of this class of supplies, and is always able to take care of its customers in the most satisfactory manner.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., states that in January nearly 80 per cent. of its lightning arrester shipments went abroad. The company will, on application, mail a copy of its new catalogue on lightning arresters, without charge. A copy of this catalogue should be in the hands of every possible buyer of lightning arresters.

THE PARAGON FAN & MOTOR COMPANY, 39-41 Cortlandt Street, New York, has issued its catalogue of fan motors which will be handled during the season of 1899. These motors have been on the market for some years, and are well known to the trade for their efficiency and excellence of construction. The Paragon fans are made in desk, wall and ceiling types. All parts are interchangeable.

THE AMERICAN AUTOMOBILE COMPANY, of Pawtucket, R. I., contemplates changing its name on account of the similarity of its title with that of another concern in the same line of trade. The company will develop its electrical work on new lines. In its motors both the field and armature are moving parts. The company claims advantages for this new design, and holds fundamental patents thereon.

THE GARLOCK PACKING COMPANY, Palmyra, N. Y., commenced business in a small way, nearly a quarter of a century ago, with one fixed principle in view, namely, that all of its productions should be of superior quality. From the fact that its business has doubled every year from the com-

mencement, it is self evident that its goods have met with favor among engineers. Its annual output, it is stated, now numbers many thousands of tons.

MESSRS. CHARLES H. BESLY & CO., 10 and 12 North Canal Street, Chicago, state that they are very busy in the tap and die department at their factory at Beloit, Wis. They are making many shipments of their new Badger non-adjustable die stock, which cuts the same size and full thread every time at one cut. Recent shipments of dies and taps were made to London, Lima, Rio Janeiro and other foreign points.

THE LOMBARD WATER-WHEEL GOVERNOR COMPANY, Boston, Mass., has received an order for three additional type "B" governors for the plant of the St. Anthony Falls Water Power Company, of Minneapolis, Minn. These governors are for the three additional units of four Victor turbines which are to be installed. This will make in all ten Lombard governors in the above named plant, regulating forty water wheels.

"YOUR CHANCE HAS COME" is the title of a neat little pamphlet issued by the International Correspondence Schools, Scranton, Pa., containing copies of letters received from many past students, testifying to the benefits resulting to them from their studies in the schools. These benefits are of the most substantial kind, and consist in being able to fill positions they could not occupy without the knowledge obtained through their studies, and, as a result, the enjoyment of better salaries.

THE PETITE ARC LAMP has been handsomely illustrated in a recent catalogue issued by the Western Electric Company, Chicago and New York. The Petite arc lamp is made in a number of different styles, so that it is suitable for use under different conditions. In the catalogue can be found some valuable information regarding the care and operation of enclosed arc lamps. As the Petite lamp is suitable for street railway plants, power circuits, and isolated plants, a copy of this catalogue should be in the hands of those connected with installations of this kind.

"NEVER-SLIP PULLEY COVERING," which is manufactured solely by the Crescent Chemical Company, 185 Dearborn Street, Chicago, is said to save power and fuel, and, consequently, money. By its use machinery may be run with sagging belts and cool journals without the use of idlers or tighteners. It also increases the life of both the belt and machinery fully 33 per cent. The covering is not affected by steam, heat, oil or dampness. This belt covering comes in liquid form, and is applied to the belt with a brush. It is put up in gallon cans, and the company sells it on a thirty-days' test on the "No cure, no pay" principle. A circular of testimonials published by the company tells a story that is convincing.

THE B. F. STURTEVANT COMPANY, Boston, Mass., very completely describes and illustrates its steel-plate fans in catalogue No. 96, just issued. This catalogue, which contains 132 pages, gives information of interest on the subject of ventilating, heating and mechanical draft. It is devoted exclusively to the illustration and description of steel-plate fans. Special attention is called to the various forms of steel-plate electric fans, which are constantly finding new adaptations as the use of electricity as a motive power is developed. Several useful tables pertaining to fans and their operation are presented, and dimensional illustrations of the various types of machines are given throughout the work. This catalogue is very completely illustrated and shows much care in its make-up.

AUTOMATIC OILING SYSTEM.—The Southern Electric Railroad Company, St. Louis, has installed the Siegrist automatic oiling system on all the engines in its power station, dispensing with three oilers heretofere employed in the plant, and saving a large sum in wages and oil. The Siegrist Lubricator Company, St. Louis, is the manufacturer of this system. After four years' use of the system in the power station of the Metropolitan West Side Elevated Railway Company, Chicago, both for cylinder and engine oil, it has been ordered for the two new Allis engines now being installed in that station. The Siegrist system has also been specified for a new ice machine and the two new Corliss engines now being installed by Armour & Co., at South Omaha, Neb.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, is distributing circulars and price lists of its Peerless fan motors and Peerless oil transformers. The armature of the motor, which is of the direct type, is enclosed in a dust-proof case. The machine is guaranteed to take 20 per cent. less current than any other motor of the same size, and operated under the same conditions, and give absolute satisfaction. The motor has a 12-inch fan and a speed of 1800 revolutions. It is said to consume less current than that required for a 10-cp lamp. The Peerless oil transformers are guaranteed to test out to a lower core loss than any other transformers yet placed on the market. They are said to regulate within 1 per cent. from 1-kw to 5-kw capacity, and within 2 per cent. in all sizes above 5-kw capacity. The company manufactures two separate lines of standard transformers, one for 125 cycles and the other for 60 cycles. It has also issued a revised price list of its lamps of all powers and types.

EDUCATION BY CORRESPONDENCE.—The correspondence system of education, which has become so successful and of such importance in the educational field, is of incalculable benefit to those who have not had earlier opportunities to obtain a technical education. This method of instruction is especially adapted to all who are so situated that they are unable to leave home, or attend college, but are anxious to perfect themselves in the theory of their profession in order that they may be better able to compete with others who have been fortunate enough to secure a college training. The system of instruction employed by the United Correspondence Schools, 156 Fifth Avenue, New York, has been gradually developed, and is the result of seven years of experience in teaching by correspondence. Their courses in mechanical, electrical and steam engineering are thoroughly practical and complete, and present a means by which a technical education may be obtained at home without interfering with business.

ACTIVITY OF J. H. BUNNELL & CO.—The business of this well-known, and, one might truthfully say, historic firm, was never more active than at present. The surviving partner, Mr. Charles McLaughlin, who has been the executive manager from the very start, has been applying his ability as an organizer and director, with marked resuts, so that while the old style of the firm is retained, the influence of his push and energy will be more pronounced than ever. The headquarters at 76 Cortlandt Street hum like a hive with customers, and the factory is crowded with new work. The old high standard established for telegraphic apparatus is to be maintained and enhanced, and in every other line the firm proposes to lift itself to a loftier plane of excellence and superiority. New catalogues are in preparation, and this week the concern issues in the seventeenth edition its "Telephone Catalogue and Students' Manual for Learners of Telegraphy." This is a book one would be glad to secure at almost any price for its practical data. It is mailed free on application, and should be secured at once.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has recently introduced a new form of rheostat for use where very high resistance is required. The use of high resistances for the regulation of field currents of motors is rapidly on the increase, and the high cost of field rheostats for motors of 500 volts or even 250 volts has been quite a drawback to such methods; but it is claimed by the Ward Leonard Company that with its new form a rheostat of many thousand ohms can be made at the same cost as one of the same watt capacity of lower ohms. The new rheostat is based upon a recent invention of Mr. H. Ward Leonard. The Ward Leonard Company reports that it now carries a complete line of Carpenter enamel field rheostats from 2 ohms to 1000 ohms, and of all commercial sizes; also all sizes of motor starters, both with automatic release and without this feature, ranging from ½ to 50 horse-power, and for 125, 250 and 500 volt circuits; and all commercial sizes of theatre dimmers, ventilating fan controllers and motor speed regulators.

WESTERN TELEPHONE CONSTRUCTION COMPANY.—The annual meeting of the stockholders of the Western Telephone Construction Company was held at its offices, 250 South Clinton Street, Chicago, Ill., Monday, March 13. The meeting was characterized by the entire harmony of the stockholders present, and the same board of directors was re-elected for the ensuing year. The thanks of the stockholders were unanimously voted to the officers for the results of the year's business. The statement of the year's business showed a large increase in the earnings of the company and in the extension of its property, the balance sheets showing assets of about $200,000 in excess of its liabilities. The orders on its books are greater than at any time in its history. It is working its factory night and day to catch up with orders. Within the last thirty days it has been enabled to increase its output by 50 per cent. through the addition of considerable machinery and new tools. It is learned that the company, some six months ago, had made very extensive contracts for raw materials involved in its product for the year 1899. The extent of this may be better shown by the fact that in one line of materials alone the difference in the market price to-day and that on which the same are contracted, amounts to nearly $30,000. It is intimated that a considerable amount of additional cash capital has just been added to the resources of the company. It will proceed to put some new devices on the market.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MARCH 14, 1899.

[In charge of Wm. Rosenbaum, 177 Times Building, New York.]

620,907. TROLLEY EAR; H. Geisenhoner, Schenectady, N. Y. App. filed Aug. 5, 1898. The trolley wire has a spiral groove in it, into which a small fastening wire is seated, the fastening wire being wound around the ear, to hold the trolley wire in place.

620,930. CIRCUIT BREAKER; T. J. Johnston, of Schenectady, N. Y. App. filed Oct. 19, 1898. A plurality of calibrating springs, which are arranged to act upon the armature in the same direction, means being provided for throwing them independently into and out of action. This is for the purpose of making the circuit breaker instantaneously adjustable to different current capacities.

620,965. ALTERNATING-CURRENT MOTOR; E. W. Rice, Jr., and C. P. Steinmetz, of Schenectady, N. Y. App. filed July 29, 1893. The object is to start under load with a large torque. An alternating current is passed through a primary winding on the inducing member, to thereby generate a current in a rotatable armature, and inducing, by the joint action of said primary winding and armature winding, a current in a second winding on the inducing member. The phase of the current in the second winding is artificially regulated; the rotation of the armature is produced by the joint action of the two windings on the inducing member.

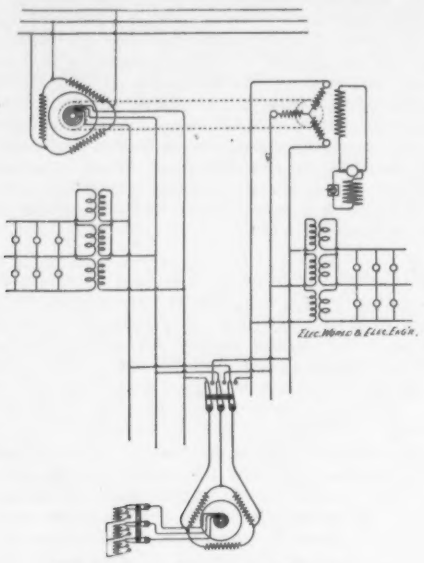
620,966. INDUCTION MOTOR; E. W. Rice, Jr., and C. P. Steinmetz, of Schenectady, N. Y. App. filed Oct. 16, 1897. A modification of the preceding invention.

620,986. FREQUENCY CHANGER; C. P. Steinmetz, of Schenectady, N. Y. App. filed Jan. 31, 1895. Two induction motors are mechanically coupled in tandem, and absorb power from a supply circuit; the working circuit is of different frequency from the supply circuit, and is connected in multiple with the secondary of one motor and the primary of the other.

620,987. FREQUENCY CHANGER; C. P. Steinmetz, of Schenectady, N. Y. App. filed Jan. 31, 1895. Consists in supplying current of given frequency to the primary of an induction motor maintained in rotation at a speed different from that corresponding to the frequency of the supply currents;

feeding one circuit with currents induced in the secondary in the motor and a second circuit with currents generated in a generator mechanically coupled with the motor and representing the mechanical energy consumed by the motor.

620,988. SELF-STARTING ALTERNATING-CURRENT MOTOR; C. P. Steinmetz and E. J. Berg, of Schenectady, N. Y. App. filed Sept. 10, 1895. It is proposed to take an ordinary three-terminal motor and connect one of its terminals to one side and one to the other side of a single-phase



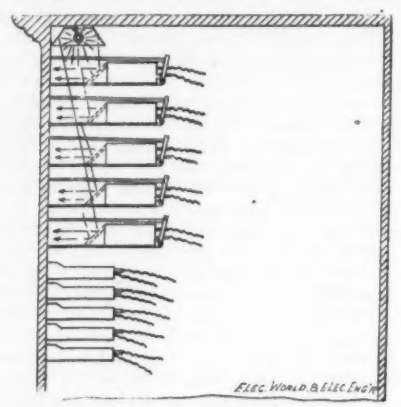
No. 620,987.—Frequency Changer.

circuit, between the lines of which any desired electromotive force is maintained. The other terminal of the motor is connected to both of the lines through phase-modifying devices.

620,989. STARTING DEVICE FOR ELECTRIC MOTORS; C. P. Steinmetz and E. J. Berg. App. filed Jan. 26, 1897. Certain improvements over the invention described in the preceding patent.

620,990. ARC LAMP; J. T. Thschierst, of Levallois-Perret, France. App. filed May 9, 1898. Details of construction affecting the regulating mechanism.

620,998. SELF-SETTING ANNUNCIATOR INDICATOR; J. E. Van Dyck, Jr., of New Brunswick, N. J. App. filed March 18, 1897. A catch bar common to a row of drops is moved by the individual drops when they are acted upon by the magnet, which motion serves to release and restore to normal position any other drop that may be in sight.



No. 621,126.—Electrical Switchboard Signal.

621,001. ELECTRICAL DEVICE INVOLVING HERMETICALLY INCASED CONDUCTORS; N. G. Warth, of Indianapolis, Ind. App. filed Dec. 9, 1897. An hermetically sealed conduit, from which the air is exhausted.

621,005. ELECTRIC METER; W. S. Weston, of Chicago, Ill. App. filed July 1, 1898. Consists of an electric motor in which the torque is reversed to produce a to and fro rotative motion, a set of swinging commutator segments, whereby the reversal takes place after the motor has passed the centre of its movement in either direction, and a dial train for recording the movement of the motor.

621,018. LOCOMOTOR FOR USE IN PIPES; E. L. Benjamin, of London, England. App. filed Sept. 13, 1898. The wheels of the small locomotive are pressed into frictional engagement with the walls of the pipe or conduit to produce sufficient traction to enable the device to haul a cable through the conduit.

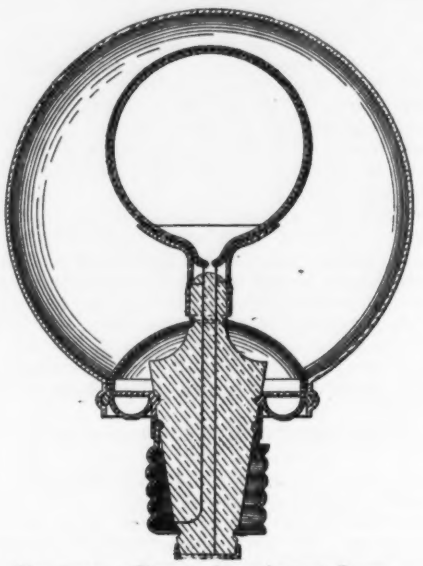
621,048. STORAGE CELL; C. P. Elieson, of London, Eng. App. filed May 9, 1898. The plate is built up of several layers of perforated and corrugated sheet lead, the layers being so placed relatively with one another that the corrugations of one layer cross those of adjacent layers, the several layers being secured together by lead rivets.

621,080. UNDERGROUND RAILWAY SYSTEM AND TRAVELING COLLECTOR; N. Henquin, of Schenectady, N. Y. App. filed March 8, 1898. The collector wheels have conducting cores and insulated sides; the conductors leading from the wheels pass up through the plow and terminate in flat springs, which bear against large copper plates carried by the car, permitting freedom of relative movement between the plow and the car.

621,093. FIRE-ALARM BOX; J. W. Johnson, of Chicago, Ill. App. filed Dec. 7, 1896. The box includes a stopping device and motor mechanism responsive thereto, a signal device adapted to be connected with the motor, a signal-arresting device and a motor-stopping device, independent of the length of time the motor is in operation, and normally held in an inoperative position, but adapted to be rendered operative in response to abnormal conditions.

621,104. COMBINED ELECTRIC AND GAS CHANDELIER; W. H. Lau, of Chicago, Ill. App. filed June 6, 1898. An improved construction of couplings.

621,126. SWITCHBOARD SIGNAL; W. E. McCormick, of Chicago, Ill. App. filed Jan. 11, 1898. Instead of using one signal lamp for each circuit, a compartment is lighted by a comparatively small number of lamps, and windows in the walls of this compartment are opened by an annunciator magnet, permitting the light to stream out where it can be seen by the operator.



No. 621,291.—Electric Incandescent Lamp.

621,150. PROCESS OF MANUFACTURING ACTIVE MATERIAL FOR BATTERIES; A. Schauschieff, of London, England. App. filed Jan. 3, 1898. Consists in mixing finely powdered carbon with formic, tartaric and sulphuric acids, and adding the active material; when cooled the mixture is made into dough-like paste.

621,205. AUTOMATIC SYSTEM FOR PREVENTING COLLISIONS ON ELECTRIC RAILWAYS; E. F. Bancroft, of Lowell, Mass. App. filed Nov. 3 1898. Consists principally in means whereby the passing of a car along a section of line will shut off the power from another section of the same line.

621,210. APPARATUS FOR SUPPORTING ELECTRIC WIRES AND AUTOMATICALLY CUTTING OFF CURRENT ON BREAKAGE OF THE SAME; N. Bostock and F. E. Cheetham, Brighouse, England. App. filed Nov. 29, 1898. The breaking of the wire releases a weight, which, in falling, cuts off the current from the loose end.

621,241. ELECTRICAL CONTROLLER; N. K. Garhart, Indianapolis, Ind. App. filed Aug. 8, 1898. A pedal device adapted particularly for dentists and surgeons for controlling the starting, stopping and speed of electrical engines.

621,263. ELECTRIC SWITCH; A. E. McCoun, of Braddock, Pa. App. filed March 28, 1898. The terminals of the circuit are split up, causing the several divisions of the current to pass through the switch in multiple, to avoid sparking.

621,267. MAGNETIC LIFTING DEVICE; A. Monell, of Homestead, Pa. App. filed May 12, 1898. A suspended, pivoted bar carrying equalizing bars at each end, to which are attached a number of electro magnets, the bars being arranged so that the lifting power will be evenly distributed among the magnets.

621,285. METHOD OF AND MEANS FOR OPERATING ELECTRIC MOTORS; C. J. Reed, of Philadelphia, Pa. App. filed July 29, 1898. The motors are operated from a divided source of electrical energy; the field circuit is divided into independent divisions, the number of which is proportional to that of the independent divisions in the source of energy; each field circuit division is supplied from a corresponding division of the source, while the armature is supplied from the combined divisions of the source of energy.

621,291. INCANDESCENT LAMP; F. M. F. Cazin, of Hoboken, N. J. App. filed Oct. 29, 1895. The luminous body consists of two layers, one of which is a material capable of producing light by its current resistance; the other is a fragile fabric of a rare metal oxide.

621,292. INCANDESCENT VACUUM LAMP; F. M. F. Cazin, Hoboken, N.J. App. filed Oct. 15, 1897. As supplemental to the preceding patent a supplemental glass bulb and air space for preserving and centering the heat which is used in heating the rare metal element, and incidentally for protecting the inner air exhausted bulb against the formation of a darkening deposit.